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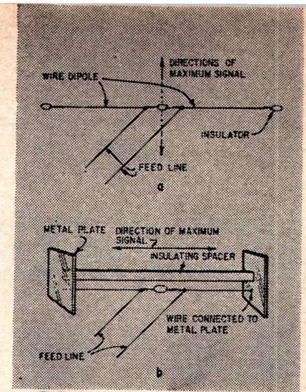
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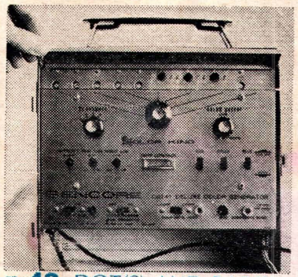

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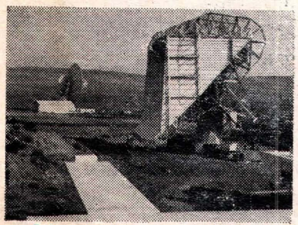

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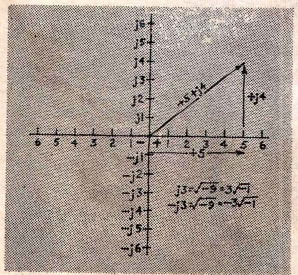

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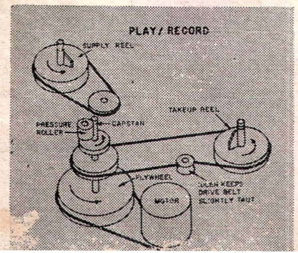

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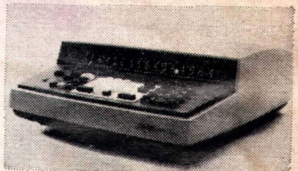

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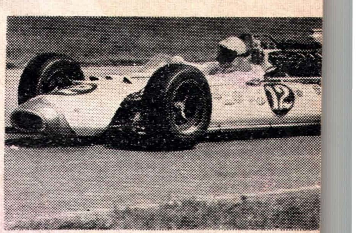

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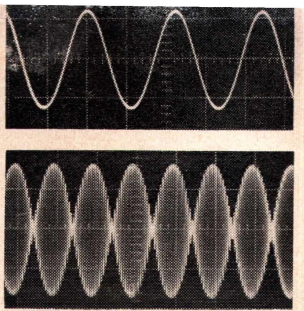

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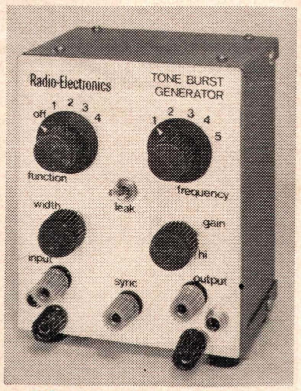

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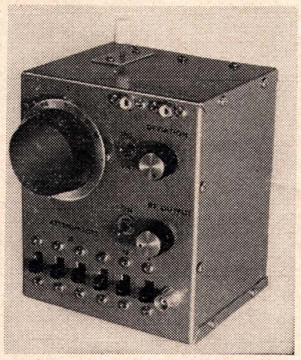

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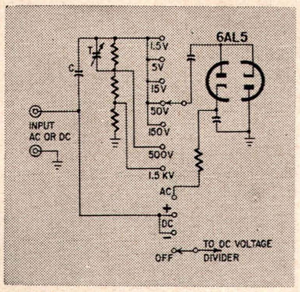

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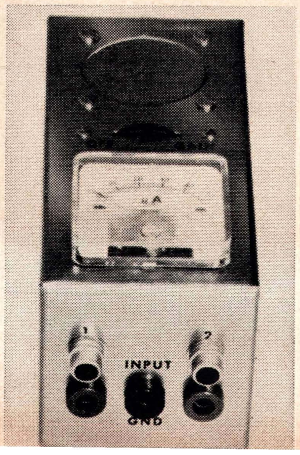

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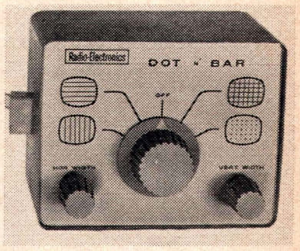

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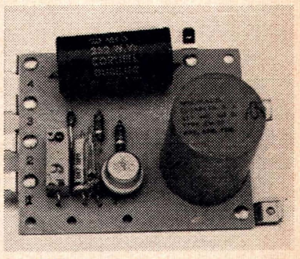

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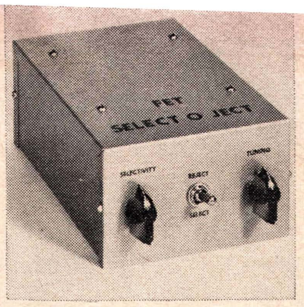

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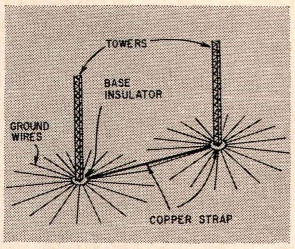

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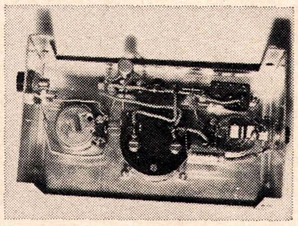

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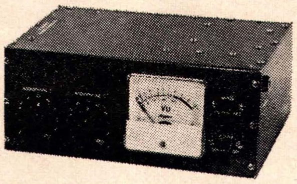

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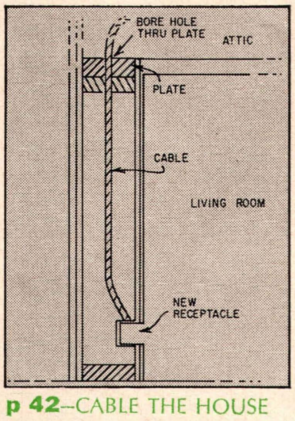

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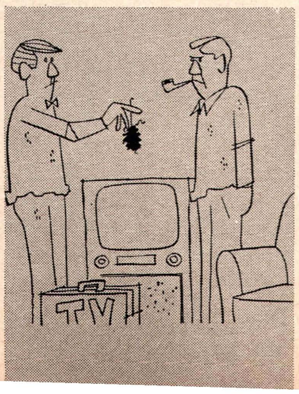

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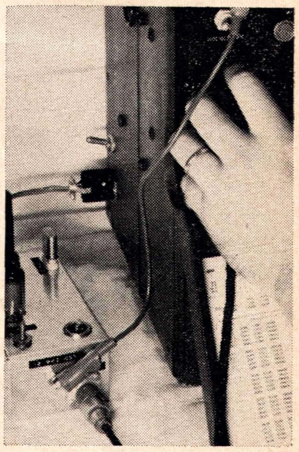

p 50—CB transmitters must be frequency-checked from time to time. This construction project lets you use a surplus BC-221 with increased accuracy for 27-MHz transmitter testing.

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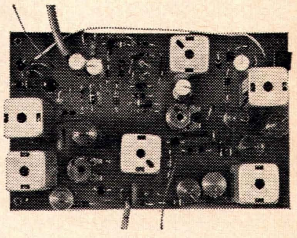

p 32—Got a mono FM tuner? Want wall-to-wall sound? Make this adapter and relax in two-channel bliss.

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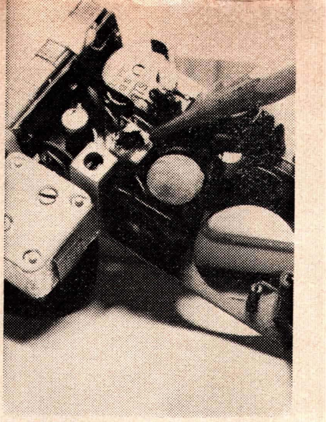
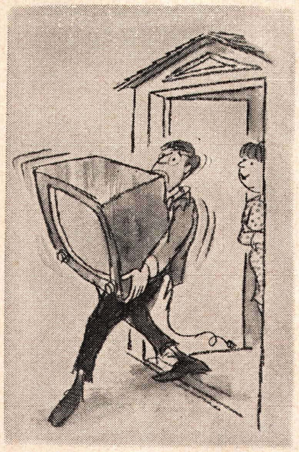
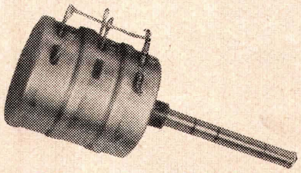


p 51—DEBUG TRANSISTORS



p 58—COULD BE WORSE



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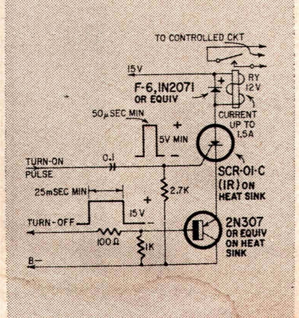

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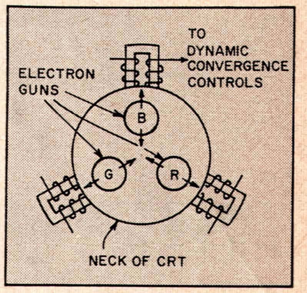

p 32—New self-teaching technique lets you learn color TV at your own rate of speed and is error-proof.

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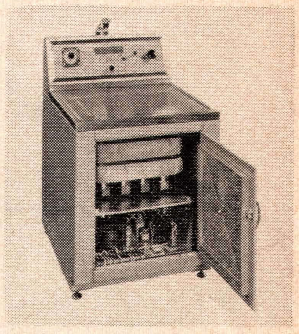

p 62—Ultrasonic cleaners are easier to fix than a TV set. Here's how they work and what can go wrong with them.

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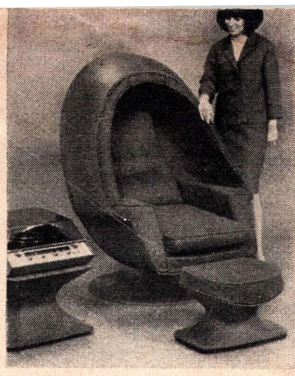

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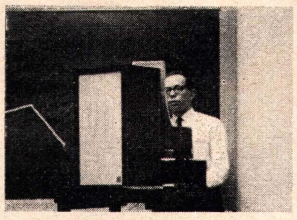

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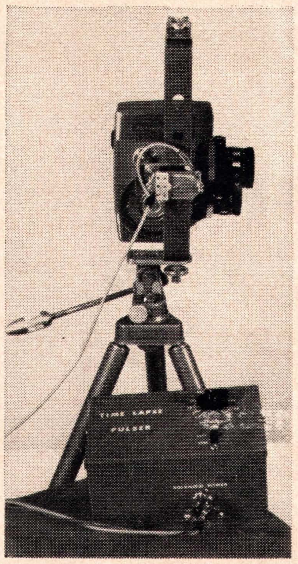

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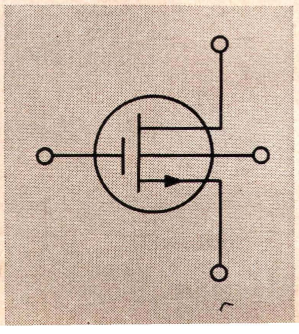

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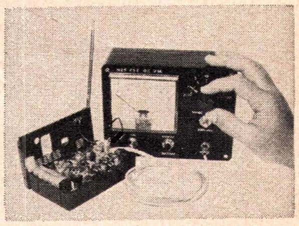
COVER FEATURE

p 32—Simple lab-type tests of stereo phono cartridges you can make in the field to adjust antiskate and stylus pressure for maximum tracking and minimum wear. Also checks for overall operation of channel separation, etc. Equipment shown: oscilloscope, Precision Apparatus, Div. of Dynascan, Model S-55A; turntable, Garrard, Synchro-Lab 75; test record, cartridge, basic amplifier and pressure gauge, Shure, C/PEK-1.



p 44—FET VOLTMETER

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Radio-Electronics

May 1970 • Over 60 Years of Electronics Publishing

ELECTRONICS IN PHOTOGRAPHY

Photographic Electronics—'70 . . . . 41 . . . . John R. Free
Automatic focusing with infrared light

Half-Hour Darkroom Timer . . . . 57 . . . . Frank Tooker
FET circuit provides long-interval timing

Electronic Flash Tester . . . . 66 . . . . . W. G. Eslick

BUILD THIS ONE

'The Ultimate' Stereo FM Tuner . . . . . . 36 . Kenneth E. Buegel
State-of-the-art performance

TELEVISION

In The Shop . . . . 24 . . . . . . Jack Darr
Divide up for efficiency

Kwik-Fix™ Troubleshooting Charts . . . . . 53 . . . Forest H. Belt
Transistor-keyed agc

Horizontal Efficiency Tester . . . . 67 . Homer L. Davidson
Meter readout saves your eyes

Service Clinic . . . . 84 . . . . . . Jack Darr

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Looking Ahead . . . . 4 . David Lachenbruch
Current happenings with future overtones

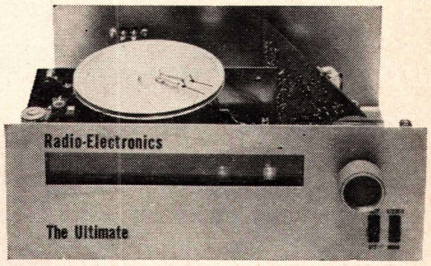
Equipment Report . . . . 26 . . . . . . Jack Darr
Hickok Digital Instrument System

Emitter-Coupled Oscillators . . . . 33 . . . . Ken Maynard
Practical experiments with E-C circuits

Easy-Build Computer Logic Circuits . . . . 44 . . . Matthew Mandl
Get to know the basic logic circuits

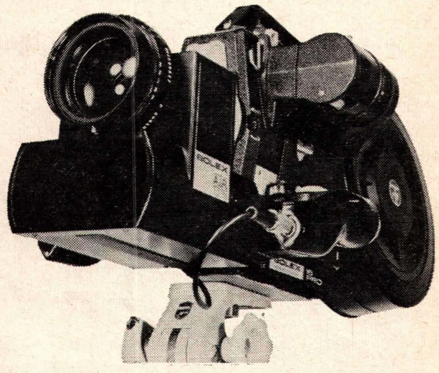
All About Tools . . . . 48 . Thomas R. Haskett
Soldering equipment (conclusion) and nutdrivers

Technical Topics . . . . 59 . . . Robert F. Scott
FM with a swept i.f. circuit



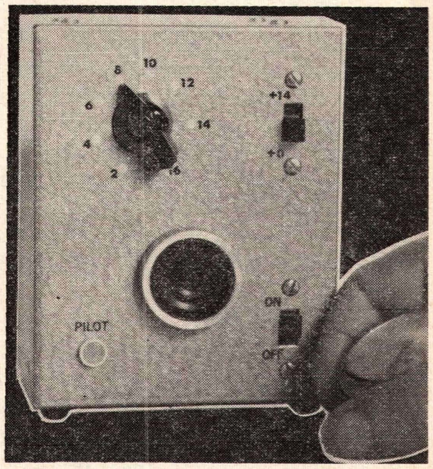
Stereo FM tuner you'll be proud to own. Unbeatable performance . . . use the three PC patterns and instructions.

. . . see page 36



Sophisticated electro-optical system added to this movie camera uses modulated light beam to focus it.

. . . see page 41



Half-hour interval timer can be used in the darkroom for accurate exposures —or anywhere in the house.

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RADIO-ELECTRONICS, MAY 1970. Vol. 41, No. 5
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Radio-Electronics

August 1970 • Over 60 Years of Electronics Publishing

TELEVISION

Inside Portable Vtr's . . . . **9** . . . . . G. McGinty
Electronic photography in a shoulder pack

Color TV Cameras . . . . **30** . . . Walter G. Salm
New designs bring the prices down

Kwik-Fix™ Troubleshooting Charts . . . . **33** . . . . Forest H. Belt
Color difference amplifiers

In The Shop . . . . **64** . . . . . . Jack Darr
Diddle adjustments for color

Service Clinic . . . . **65** . . . . . . Jack Darr

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How they work—including a 44-IC wristwatch

Build: Multipurpose IC Digital Clock . . . . **46** . . . . . Leo Walker
12 or 24 hours with a timer alarm and more

Build: Superaccurate IC Digital Clock . . . **54** . . Lindsey G. Riddle
10-MHz crystal time base

BUILD THIS ONE

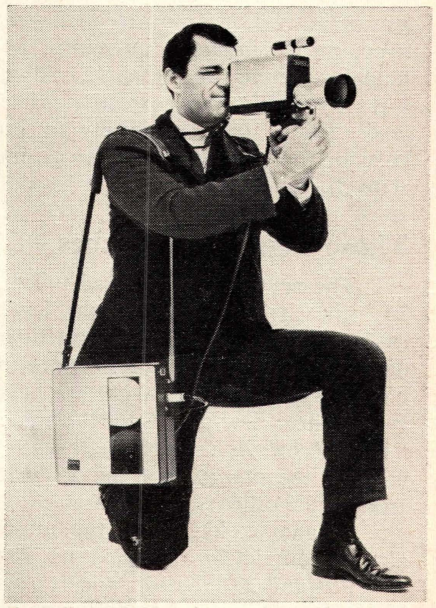
Charger for Rechargeable Alkaline Batteries **52** . . . . H. R. Mallory
Money-saving unit handles 1 to 10 cells

GENERAL ELECTRONICS

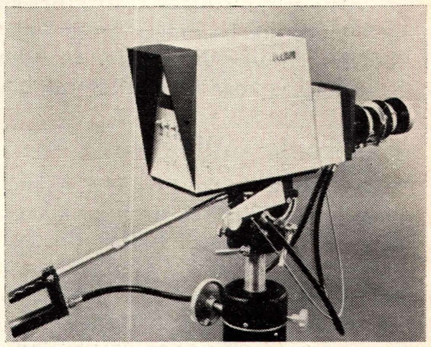
Looking Ahead . . . . **4** David Lachenbruch
Current happenings with future overtones

30 CA3018 IC Projects . . . . **22** . . . R. M. Marston
Four-transistor device operates from dc to vhf—part 1

Versatile IC Digital Clock offers variety of precise timing functions. Build 12- or 24-hour version with a minute alarm. . . . see page 46



Portable vtr's give you up to ½-hour of "point-and-shoot" electronic photography. Find out how the latest models work. . . . see page 9



Color TV cameras used to carry five-figure price tags until this one-tube model hit the market. How long before under-$1,000 versions are available? . . . see page 30

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RADIO-ELECTRONICS, AUGUST 1970. Vol. 41, No. 8
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Radio-Electronics

FOR MEN WITH IDEAS IN ELECTRONICS

August 1972

SPECIAL FEATURES

23 **State of Solid State**
New regular feature explores the worlds of solid-state electronics today. **by Lou Garner**

33 **Fiber Optics—Today!**
A once-over-thoroughly of the what's new and what's happening in fiber optics for electronics. **by Michael D. Doering**

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51 **Kwik-Fix Troubleshooting Charts**
Last article in this series discusses automatic brightness. **by Forest H. Belt**

58 **Reducing TV Interference**
How to handle five different types of interference troubles in solid-state TV receivers. **by Matt Mandl**

63 **Service Clinic**
Diagnosis puzzler. **by Jack Darr**

68 **Reader Questions**
R-E's Service Editor solves reader service problems.

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38 **Zirconium Arc Projector**
Simple project; powerful light. **by Harold Pallatz**

39 **Digital Electronic Stopwatch**
Use RCA Hobby Kits to make this unit. It counts by tenths of a second to 9 minutes 59.9 seconds. Can be made to count longer intervals too. **by B. R. Rogen**

54 **Touch Switch**
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72 **Fiber Optics Suppliers**
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42 **Vom—Vtvm—Tvm**
How they work and how to use them. Some of the unusual applications described may surprise you. **by James R. Huffman**

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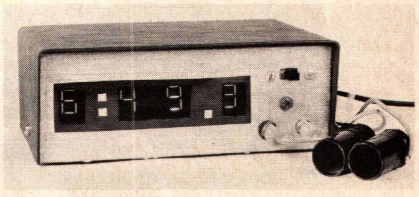
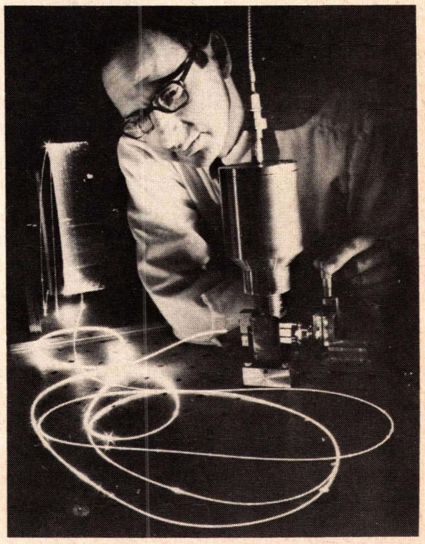


ELECTRONIC STOPWATCH uses modular construction to make it easy to duplicate. Measures time intervals from 0.1 second to 9 minutes 59.9 seconds. ....see page 39



FIBER OPTICS are playing an ever-growing role in modern electronics. Do you know about all the latest developments?............see page 33

Hugo Gernsback (1884-1967)
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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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FEBRUARY 1976 Vol. 47 No. 2

BUILD ONE OF THESE

33 **Electronic Thermometer With Biofeedback Output**
It not only measures temperature accurately, it helps you train your mind to control your body.
by Mitch Waite

40 **555 IC Timer Circuits**
Part I: A look at the 555 and circuits you can build around it. **by Robert F. Scott**

57 **Calculator-Stopwatch**
Part II: Final instructions on assembling this valuable unit. **by Tim Tyler**

60 **Pocket Data Terminal**
Part II. Automatic dialing add on you can build.
by Charlie Edwards

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Sneak preview of tomorrow's news.
by David Lachenbruch

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Elements in a computer. **by Tim Barry**

22 **State Of Solid State**
New IC's and applications prepared by our Semiconductor Editor. **by Karl Savon**

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43 **New FM Tuner Standards**
There are new rules for checking FM tuner performance. Our Hi-Fi Editor reports on the new standards. **by Len Feldman**

52 **R-E Lab Tests Sansui 9090**
Stereo. AM/FM receiver gets a going over.
by Len Feldman

55 **R-E Lab Tests Yamaha TC-800 GL**
Portable cassette recorder comes up looking great.
by Len Feldman

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Jerrold L-200 Levelite.

20 **Equipment Report**
Sencore DVM-32.

30 **Equipment Report**
Hickok 440 Curve Tracer.

50 **All About Probes**
Part II: More ways to use these vital accessories. **by Charles Gilmore**

62 **Step-By-Step Troubleshooting Charts**
Video sweep modulation can help speed servicing.
by Stan Prentiss

69 **Service Clinic**
Bits and pieces. **by Jack Darr**

100 **Reader Questions**
R-E's Service Editor solves reader problems.

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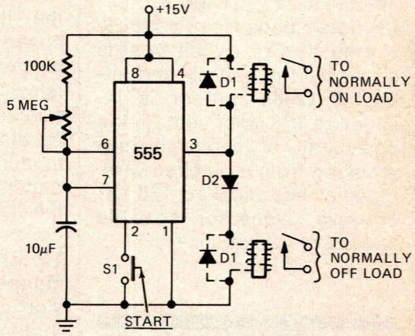
That's a very special sort of electronic thermometer . . . it does much more than just tell you the temperature. It also makes it possible for you to do some biofeedback training in a direct effort to control your own body's temperature. Try it yourself. The story starts on page 33.



TIMER CIRCUIT APPLICATIONS are easy to use when there's a 555 IC around. Look into a flock of circuits this issue.

. . . turn to page 40

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Electronics publishers since 1908

MARCH 1976 Vol. 47 No. 3

STEREO AUDIO HI-FI

33 **R-E Tests Heath Modulus System**
Hi-fi system in a kit that can be expanded to 4-channel in any or all its variations. **by Len Feldman**

38 **Record Changer Buyers Guide**
How to select the changer that's right for you. **by Herb Friedman**

41 **Record-Care Breakthrough**
Spray-on coating makes records last longer and may reduce stylus wear. **by Len Feldman**

69 **Understanding Tape Specs**
What is really important when you decide which tape is best for you. **by Len Feldman**

76 **Where 4-Channel Went Wrong**
Why isn't 4-channel the booming success predicted for it? **by Herb Friedman**

BUILD ONE OF THESE

48 **Electronic Fuse**
Reacts in microseconds to excessive power loads. Protect all kinds of delicate equipment. **by Mitch Waite**

51 **ASCII To BAUDOT Converter**
Add to your computer system for easy conversion from one code to another. **by Roger Smith**

62 **555 IC Timer Circuits**
Part II: Lots of simple circuits that you can make with this popular IC. **by Robert F. Scott**

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Sneak preview of tomorrow's news. **by David Lachenbruch**

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Basic computer elements. **by Tim Barry**

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30 **Equipment Report**
Vector P173 Wiring Pencil

24 **Equipment Report**
Telematic KP-710 Pix-Mate

59 **Evaluating Color Receivers**
What's really important in color TV circuits. **by Stan Prentiss**

71 **Service Clinic**
Bang Bang Servicing. **by Jack Darr**

74 **Reader Questions**
R-E's Service Editor solves reader problems.

81 **All About Probes**
Part III: Final installment wraps up the story on these vital test instrument accessories. **by Charles Gilmore**

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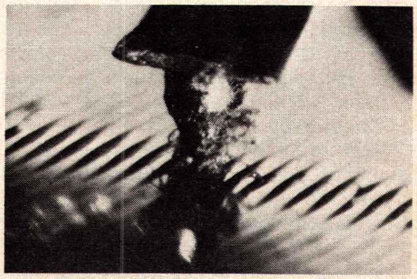
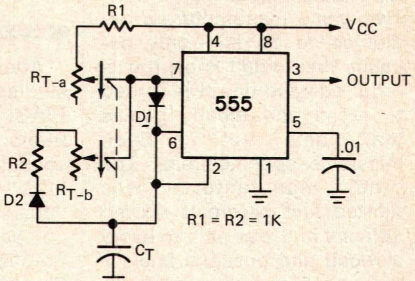
ON THE COVER

Fan of circuit boards are the secret element in making the Modulus system so versatile. For a detailed performance report, see story starting on page 33.



RECORD DESTRUCTION occurs each time the stylus traces the grooves of your record. You can prevent this from happening and extend record life and performance.

. . . turn to page 41



TIMER CIRCUITS are easy to design and fun to use when there is a 555 IC around. There's a flock of these circuits in this issue.

. . . turn to page 62

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NOVEMBER 1977 Vol. 48 No. 11

SPECIAL FEATURE

49 **WHAT YOU NEED TO KNOW ABOUT CB TEST GEAR.** by Forest Belt
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- 55 Digital Multimeters
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- 58 Dummy Loads & RF Wattmeters
- 59 Test Systems

BUILD ONE OF THESE

33 **Digital Biorhythm Clock**
Three pairs of digits—2 green, 2 red, 2 yellow tell you your status at a glance. And it costs less than $30 to build. **by Fred Blechman**

45 **Remote Telephone Ringer**
Plug it in anywhere in your house. It rings when your phone does. **by R.K. Atwood**

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Understanding the new standard. **by Len Feldman**

65 **R-E Lab Tests Sherwood Micro CPU100**
Here's an FM tuner that earns a "Superb". **by Len Feldman**

67 **R-E Lab Tests Spectro Acoustics 101B**
Preamp Equalizer rated "Very Good". **by Len Feldman**

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Preview tomorrow, today. **by David Lachenbruch**

41 **Digital Car Clocks**
Part II: Model-by-model coverage of the entire digital car clock market. **by Fred Blechman**

78 **Computer Corner**
Inside the Z80 with a look at how it differs from the 8080. **by William Barden, Jr.**

80 **State Of Solid State**
A number-oriented microprocessor plus NMOS and bipolar monochips. **by Karl Savon**

69 **Hobby Corner**
Breadboards for the experimenter & hobbyist. **by Earl R. "Doc" Savage K4SDS**

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38 **All About Circular Polarization**
An old technique now applicable to TV broadcast and reception promises vastly improved reception for many viewers. **by Robert F. Scott**

74 **Jack Darr's Service Clinic**
The absent-minded battery. **by Jack Darr**

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R-E's Service Editor solves technician problems.

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22 **Tiger Cub Breakerless Ignition**

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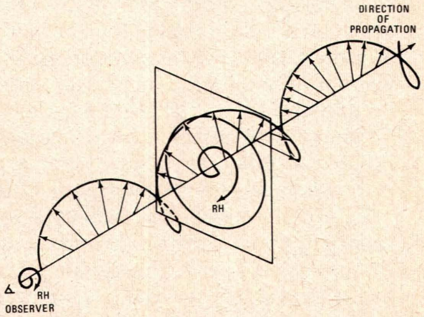
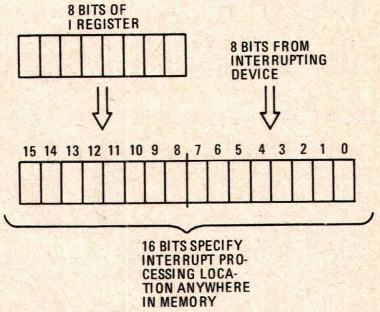
ON THE COVER

Biorhythm clock keeps you up to date on good versus bad days. Three-color digital readout tells at a glance where you are in your Physical, Intellectual and Sensitivity cycles. For full details on how to build your own turn to page 33.



RIGHT-HAND POLARIZED TV signal can bring better TV reception in US. For the whole story turn to page 38 now.


8 BITS OF I REGISTER
8 BITS FROM INTERRUPTING DEVICE
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
16 BITS SPECIFY INTERRUPT PROCESSING LOCATION ANYWHERE IN MEMORY

INTERRUPT PAGE MONITOR is one aspect of the Z-80 microprocessor. For more data on the Z-80 see Computer Corner on page 78.

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FEBRUARY 1978 Vol. 49 No. 2

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37 **Digital Bicycle Speedometer**
Measures from 0–30 MPH. Discrete LED readout. NiCad battery power supply. **by Robert Beaber**

41 **Programmable Drums**
Tap out the beat with your fingertips when you use this add-on with your hi-fi system. Touch switches make it easy to play. **by John Simonton**

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Everything you ever wanted to know about who makes it and exactly what it is that they make. **by Chester H. Lawrence**

72 **Z-80 Computer Corner**
The Z-80's addressing modes.
by William Barden, Jr.

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1978 is "THE" year of the VTR. See what you can get now, and it can do for you. **by Fred Petras**

68 **Sherlock Holmes And The Missing Transistor Clues**
Wherein the master detective solves the three most baffling problems in all transistordom. **by Gerald E. Williams**

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Smoke detector circuits. **by Karl Savon**

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Pioneer CT-F1000 earns an "*Excellent.*"

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Find faults, then fix them.
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34 **Triplett 3300 Digital VOM**

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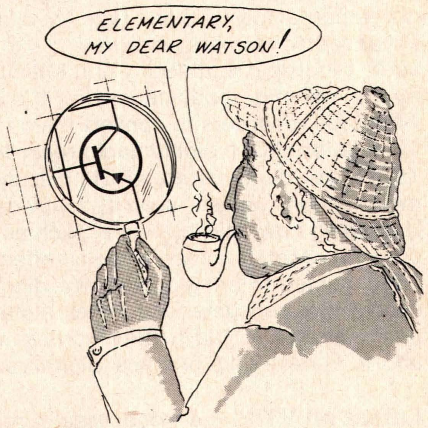
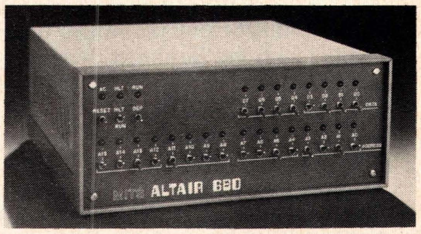
123 **Readers Service Card**

ON THE COVER

We've combined an Apple II hobby computer, an RCA Videotape machine and an RCA 19-inch color TV to put this month's cover together. We used the VTR to record the many different color displays the Apple produced. For more info on hobby computers turn to page 45. If it's the VTR you want to know about turn to page 52.


ELEMENTARY, MY DEAR WATSON!

JOIN THE MASTER SUPER SLEUTH as he untangles a baffling web of clues and fixes the mysterious Oriental amplifier. Turn to page 68.



COMPUTER MAINFRAMES. For a look at who's offering what, turn to page 45.

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Radio-Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

MARCH 1978 Vol. 49 No. 3

SPECIAL SECTION

49 **What You Need To Know About Servicing CB Radios**
by Forest Belt
50. Repair Low Cost CB's Profitably
52. Efficiency in CB Service Estimates
53. DC Trouble Up Front
58. Transmitter Keying
61. Servicing Synthesizers
63. 23-Channel PLL

BUILD ONE OF THESE

35 **Portable Frequency Counter**
Palm-sized 30 MHz counter with a 4-digit LED display that delivers 6-digit resolution. **by Gary McClellan**

40 **Digital Multimeter**
Start by building a 3½-digit panel meter; add a few shunts and range switches, and end up with a digital multimeter.
by Dr. E. H. Borneman and Robert Benward

45 **Programmable Drums—Part II**
Conclusion of a 2 part series for a hi-fi add-on that lets you tap out a beat with your fingertips. **by John S. Simonton, Jr.**

COMPUTERS

68 **Z-80 Computer Corner**
A look at the different interrupts available with the Z-80 CPU.
by William Barden, Jr.

70 **Mainframe Roundup—Part II**
Conclusion of who makes what and what it is they make.
by Chester H. Lawrence

GENERAL ELECTRONICS

4 **Looking Ahead**
Tomorrows news today. **by David Lachenbruch**

76 **Hobby Corner**
A game circuit you can play with. **by Earl "Doc" Savage**

88 **Police Radar Detectors**
A look at the latest equipment.

100 **Teaching Digital Counters To Count**
How to make a decade counter IC count by some number other than 10. **by Fred Blechman**

TELEVISION

80 **Service Clinic**
Vertical OTL (Output Transformerless) output stages. **by Jack Darr**

81 **Service Questions**
R-E's Service Editor solves reader problems.

EQUIPMENT REPORTS

24 **Motorola HEP Educator II Microcomputer kit.**

26 **Tenna PS69RD Mindblower stereo speaker/amplifier for your car**

32 **Sabtronics 2000 Digital Multimeter**

66 **Hi-Fi Lab Tests B.I.C. Beam Box indoor FM antenna**

108 **Sencore CB42 CB Analyzer**

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94 **New Products**
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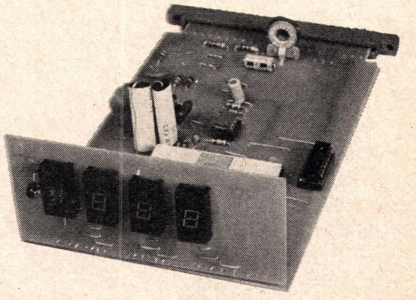
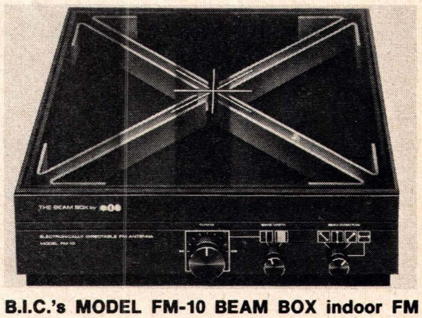
141 **Readers Service Card**

ON THE COVER

This month's feature construction project is a hand-held portable frequency counter. The unit measures to 30 MHz with a 90 mV sensitivity. The readout is a 4-digit LED display that provides 6-digit resolution. A must for any workbench. The complete construction details start on page 35.



A BASIC DIGITAL PANEL METER. Turn to page 40 to see how to build this and then turn it into a complete digital multimeter.



B.I.C.'s MODEL FM-10 BEAM BOX indoor FM antenna. R-E's Hi-Fi Lab puts it through its paces. For a complete report, turn to page 66.

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APRIL 1978 Vol. 49 No. 4

BUILD ONE OF THESE

37 **Digital Tachometer For Car Or Boat**
2-digit LED display. Works with 2- or 4-cycle; 4-, 6- or 8-cylinder engines.

46 **Tuner Frequency Display**
Part II: Add on 4-digit display for easy reading of AM or FM tuned frequency.

JUST FOR EXPERIMENTERS

67 **Modifying Electronics Hardware**
Make your own low-cost custom hardware to suit your own needs—it's easy.

82 **Hobby Corner**
Part I of a special 2-part story on breadboarding and prototype systems.

COMPUTERS

45 **All About The S-100 Bus**
Identification, voltages and signals to interface a microcomputer.

51 **S-100 Directory**
Plug-ins for the bus.

80 **Z-80 Computer Corner**
Part VI: Completes our coverage of the Z-80.

IC DATA SHEET

74 **XR-2208 Operational Multiplier**
Specs and applications for nifty things you can build.

STEREO HIGH-FIDELITY

52 **New RIAA Equalization For Records**
Delivers more dynamic range, requires preamp changes you can do yourself.

59 **R-E Lab Tests Toshiba ST-910 FM Tuner**
It gets a *"Perfect"* for dial tuning accuracy.

61 **R-E Lab Tests U.S. Pioneer RT-707 Tape Deck**
It earns a *"Superb"* for 3¾-IPS wow and flutter.

GENERAL ELECTRONICS

4 **Looking Ahead**
Preview of tomorrow.

40 **Unusual Digital Clocks**
They tick, they chime, they swing—see how they work.

63 **Selecting DMM's**
What to look for when buying a digital multimeter. Get the most for your money.

72 **All About Audio Oscillators**
Everything you ever wanted to know about this valuable piece of test equipment.

79 **VTR Update**
Latest data on video tape recorders. Updates our February 1978 report.

84 **State Of Solid State**
Delta modulation IC decodes and encodes.

TELEVISION

86 **Jack Darr's Service Clinic**
Troubleshooting horizontal sweep circuits.

87 **Service Questions**
Jack Darr solves technician problems.

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26 **Wilson Frequency Counter**
26 **Huntron Circuit Tester**
34 **Kager Soldering Pistol**
119 **Hickok CB Signal Generator**

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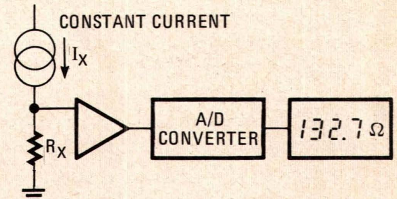
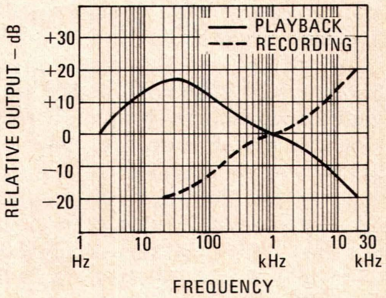
157 **Readers' Service Card**

ON THE COVER

Ever see electronic clocks with digital readouts equipped with pendulums and tick-tock sound and chimes? We did! And here's a story on how they operate. It's an exploration into interesting circuitry you may not have seen before. The story starts on page 40.



OHMS CONVERTER IS A VITAL section of a digital multimeter. It's only one of many items to be considered when selecting a unit. For full selection data turn to page 63.



NEW RIAA EQUALIZATION CURVES. Note the rolloff in playback response in the low-frequency region. For full details turn to page 52.

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JUNE 1978 Vol. 49 No. 6

PERSONAL COMPUTERS SPECIAL SECTION

37 **Your Own Computer**
- 38 **Personal Computers—are they right for you?**
- 43 **Peripherals—arms and legs**
- 47 **Programing isn't simple**
- 56 **Computer Corner**
- 59 **Equipment Directory**

BUILD ONE OF THESE

69 **Digi-Toll Times Your Calls**
Know how much your long-distance calls cost. Nifty toll-timer helps you keep track.

78 **LED Bar Graph**
LEDs all in a row serve as an analog meter in many applications.

82 **Graphic Equalizer For Stereo Systems**
Part II: Final construction details and some additional interior photographs.

GENERAL ELECTRONICS

4 **Looking Ahead**
Tomorrow's news today.

73 **Cabinets For Projects**
Directory of cabinets you can use to house your projects.

80 **Audio Oscillators**
Part II: More information on this old standby test instrument.

90 **Hobby Corner**
Keeping records, tool holders, grinding PC boards and reader suggestions.

92 **State of Solid State**
A single IC adds true RMS voltage measurements to a multimeter.

94 **Solar Controller**
Microprocessor runs solar heating system.

124 **What Is An LCD?**
Inside the Liquid-Crystal Display.

TELEVISION

88 **New MATV System**
It's easier to install and costs less to run. The circuitry is what makes it run.

96 **Service Clinic**
Write it down—it's a dollar saver.

98 **Service Questions**
R-E's Service Editor solves reader problems.

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24 **B & K 1820 Frequency Counter**
26 **Hickok 517 Dual Trace Scope**
28 **Heath 5280 Test Instruments**
35 **Spyderco Portable Hand**

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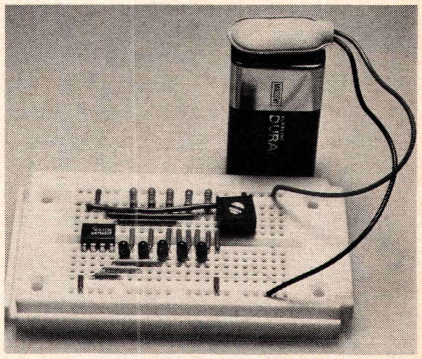
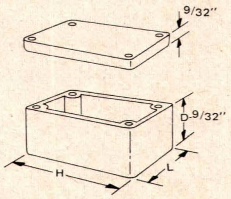
157 **Reader's Service Card**

ON THE COVER

When you want to keep track of long-distance phone charges, the first thing you need is a record of how long you've been talking. Digi-Toll does just that. It also reminds you, with a bright red digital readout right at your phone, of how long you've been talking. See construction details starting on page 69.



LED BAR GRAPH is a nifty substitute for an analog meter . . . and it's easy to read. Turn to page 78



CABINETS FOR PROJECTS helps answer that problem question of "What cabinet should I use?". Five pages of listing start on page 73.

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Electronics publishers since 1908

MAY 1979 Vol. 50 No. 5

BUILD ONE OF THESE

35 **Time/Voltage Calibrator**
Provides the time and voltage references that you must have to calibrate your digital test equipment.

40 **Bowling Game**
Electronic game that simulates rolling that ball down the alley. Requires some mechanical construction.

59 **Audio Test Station**
Part 4—The voltmeter and digital frequency meters are described.

GENERAL ELECTRONICS

4 **Looking Ahead**
Tomorrow's news—today.

6 **What's News**
Pictures and briefs of news highlights.

44 **What's New in Rechargeable Batteries**
NiCad, Alkaline . . . and now Lithium.

86 **Computer Corner**
Direct memory access—What it is and how it's used.

94 **State of Solid State**
The mysterious I^2L logic process revealed.

HI-FI STEREO PRO-SOUND

47 **Buyers Guide to Hi-Fi Amplifiers**

- 48 **How to Select the Best Amplifier**
- 53 **Front-Panel Controls and Features**
- 55 **Amplifier Specifications Roundup**

RADIO

64 **Troubleshooting CB Receivers**
Basic circuits and suitable test equipment.

68 **Communications Corner**
New monthly column devoted to developments in CB, SWL, UHF, VHF, and amateur radio.

80 **Hobby Corner**
BFO for shortwave receivers helps clarify reception.

TELEVISION

98 **Jack Darr's Service Clinic**
Fast recovery diodes and DC power supplies.

98 **Service Questions**
R-E's Service Editor solves technician problems.

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24 **Heath H17 Floppy Disc System**

26 **Sylvania Module Extension Cable Kits**

32 **Microproducts Apple II Assembler/Editor**

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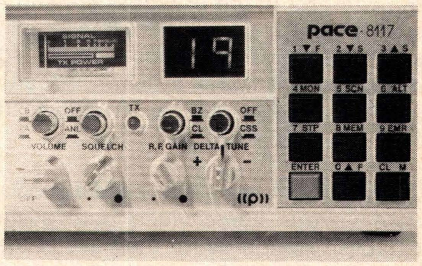
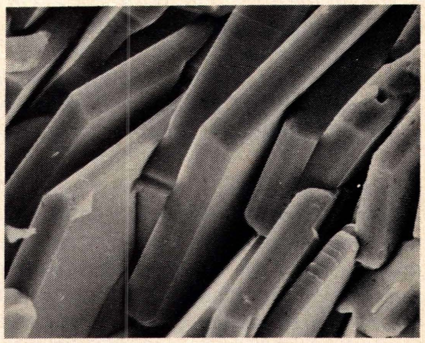
102 **New Products**
103 **Stereo Products**

ON THE COVER

A Time/Voltage Calibrator is a must if you have digital test equipment. It's the only way available to most of us to keep our test gear calibrated. Learn how to build your own calibrator. Story starts on page 35.



PACE 8117 is a computerized CB transceiver. For more data see our new Communications Corner on page 68.



TITANIUM DISULFIDE COMPOUND is used in new Exxon rechargeable lithium battery. Read the whole story starting on page 44.

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JANUARY 1980 Vol. 51 No. 1

SPECIAL FEATURES

37 **PUT AN ANDROID IN YOUR HOME**
Hints on designing an intelligent robot. **Martin Weinstein**

55 **BACKYARD SATELLITE TV RECEIVERS**
So you want to build an inexpensive earth station—well here's what you need to know. **Robert Cooper**

BUILD

40 **SLOT MACHINE**
Easy to build; fun to use. Hit the jackpot if you can.
Fred Blechman and David McDonald

49 **CONFERENCE CALLER FOR YOUR PHONE**
Add one to your phone today.
Jules Gilder

52 **TRS-80 BREADBOARD**
Part 3: Now that it's complete here are some practical applications.
Jon Titus, Chris Titus, David Larsen

TECHNOLOGY

5 **LOOKING AHEAD**
Tomorrow's News Today. **David Lachenbruch**

45 **HOW TO IDENTIFY UNMARKED IC's**
Computer board bargains really pay off when you know how.
Kirtland H. Olson and Ann L. Zevnik

50 **50 YEARS OF RADIO**
Reprinted from 1956, this article tells how radio was 73 years ago.

66 **NEW IDEAS**
A winning circuit application from our readers.

68 **HOBBY CORNER**
Easy to build circuit monitors sound level; lets you know if it rises above or falls below a preset level. **Earl (Doc) Savage**

STEREO

60 **R.E.A.L. SOUND LAB TESTS REALISTIC RECEIVER**
Realistic model STA-2200 rates Very Good. **Len Feldman**

63 **WHAT'S IMPORTANT IN TURNTABLE DESIGN**
A look at the factors in turntable design that affect how your records wear and play. **Len Feldman**

VIDEO

74 **JACK DARR'S SERVICE CLINIC**
Christmas-tree pattern reveals itself again. **Jack Darr**

74 **SERVICE QUESTIONS AND ANSWERS**
R-E's Service Editor solves technician problems.

RADIO

72 **COMMUNICATION CORNER**
Recording tells all about shortwave listening plus a tri-band monitor antenna. **Herb Friedman**

EQUIPMENT REPORTS

24 **PANASONIC RF-2900 PORTABLE MULTIBAND RADIO**

26 **RADIO SHACK SYSTEM SEVEN STEREO**

32 **B & K E-200D RF SIGNAL GENERATOR**

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79 **Stereo Products**
14 **What's News**

ON THE COVER

The radio-controlled R2-D2™ robot toy manufactured by Kenner Products contains two PC boards, 3 motors, a 3-cell battery pack and even a speaker, but it has nowhere near the capability of a true android. To find out what a household android would require and how you can go about designing your own, turn to page 37.

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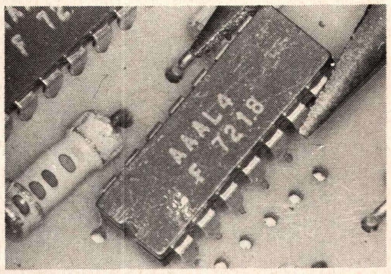
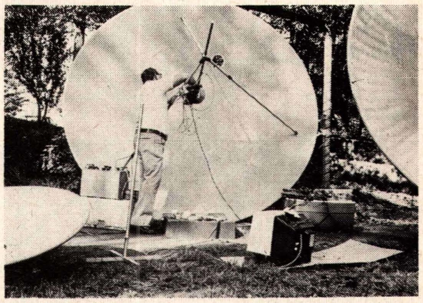


IDENTIFYING UNMARKED IC's can be a real headache unless you know how to go about it. The full story starts on page 45.



THIS INEXPENSIVE SATELLITE ANTENNA makes backyard reception of satellite TV broadcasts a reality. If you're interested in building an inexpensive earth station, turn to page 55.

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FEBRUARY 1980 Vol. 51 No. 2

BUILD

43 **AUDIO POWER LEVEL METER**
Hook it up to your hi-fi and protect your amplifier and speakers against power overload. **Joseph Gorin**

47 **SATELLITE TV EARTH STATION**
Build your own backyard installation for under $1000. **Bob Cooper**

56 **VERSATILE SWITCHING REGULATOR**
This circuit can be programmed for step up, step down, positive, negative, voltage and current regulation. **Robert Frostholm**

61 **NOT JUST ANOTHER DIGITAL CLOCK**
5½-inch high single-digit LED readout makes this clock unique. **John D. Warobiew**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

53 **HOUSEHOLD ANDROID**
Hints on how to design your own. **Martin Bradley Weinstein**

STEREO

66 **UNDERSTANDING TURNTABLE SPECIFICATIONS**
A look at the factors that affect how your records wear and play. **Len Feldman**

69 **R.E.A.L. SOUND TESTS TECHNICS CASSETTE DECK**
Technics model RS-M7 rates Very Good.

VIDEO

71 **JACK DARR'S SERVICE CLINIC**
Automatic brightness limiters. **Jack Darr**

72 **SERVICE QUESTIONS AND ANSWERS**
R-E's Service Editor solves technicians' problems.

EQUIPMENT REPORTS

26 **Speakerlab Model 2.5 Speaker System**

32 **Simpson Model 380 Microwave Leakage Tester**

34 **SF Model STD-36 Radio Operating Desk**

36 **Panasonic Model RF4900 10-Band Receiver**

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6 **What's News**

ON THE COVER

The LED bar-graph audio power level meter shown is not a wattmeter, but a level indicator that is calibrated to your amplifier's clipping level. Use the device to protect your amplifier and speakers from power overloads. Shown in contrast to the LED bar-graph display is an analog power level meter. Get started building your own LED bar-graph power level meter today. Construction details start on page 43.

ANNUAL INDEX JANUARY—DECEMBER

1979

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size)* to:

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Annual Index
45 East 17th Street
New York, NY 10003

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MARCH 1980 Vol. 51 No. 3

SPECIAL FEATURES

46 **NIFTY WIRE-WRAP TRICKS**
A few tricks that make wire-wrap projects easier, quicker and sturdier to build. **Otto Slack**

53 **SPEECH SYNTHESIZERS**
Part 1—The new breed of circuits that talk back.
Martin Bradley Weinstein

BUILD

35 **AUTOMOTIVE BURGLAR ALARM**
Build it for less than $20. Automatic feature protects your car without having to turn the alarm on or off.
Steve R. Stout

38 **BACKYARD SATELLITE TV RECEIVER**
Details of the LNA front-end gets you started building your own backyard installation. **Robert B. Cooper, Jr.**

56 **THUNDERSTORM ALARM**
Simple radio accessory provides early warning of approaching storm. **Calvin R. Graf**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

12 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry.
Robert B. Cooper, Jr.

48 **IC APPLICATION NOTE**
14 nifty applications for Harris Semiconductor's HA-2400 programmable amplifier.

60 **HOBBY CORNER**
A digital temperature sensor, a mosquito repelling circuit, plus more. **Earl "Doc" Savage, K4SDS**

64 **NEW IDEAS**
A winning circuit application from our readers.

AUDIO

57 **SUPER CLASS-A AUDIO AMPLIFIERS**
New circuit technique radically reduces crossover distortion. **Len Feldman**

VIDEO

42 **WHAT'S NEW IN 1980 TV RECEIVERS**
A look at the new circuitry being introduced in this year's TV sets. **Karl Savon**

66 **SERVICE CLINIC**
Troubleshooting automatic brightness limiters. **Jack Darr**

67 **SERVICE QUESTIONS AND ANSWERS**
R-E's Service Editor solves technician's problems.

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25 **RCA Mini-State TV Antenna**
30 **Data Precision Model 938 Digital Capacitance Meter**
32 **American Beauty Micro-Soldering Station**

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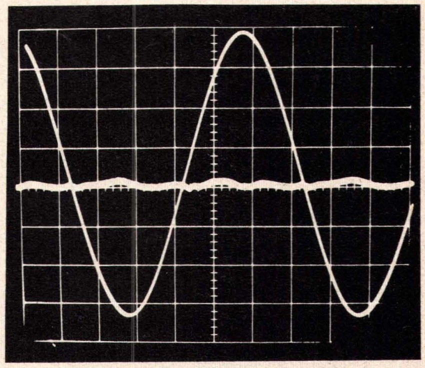
6 **What's News**

ON THE COVER

Featured on our newly designed cover is OK Machine and Tool Corporation's *Just Wrap* tool shown being used to wire wrap a prototype board. Also shown is Vector Electronics *P183* forming and cutting tool.

Wire-wrap construction has many advantages over printed circuit boards for prototype construction. However, there are also several disadvantages. To find out how to overcome many of these disadvantages and how to make your wire-wrap projects faster, easier and sturdier, turn to page 46.



SUPER CLASS-A AMPLIFIER uses new circuit techniques to radically reduce crossover distortion without any of the drawbacks associated with negative feedback. To discover how it's done, turn to page 57.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Controlled Circulation Postage Paid at Concord, NH. One-year subscription rate: U.S.A. and U.S. possessions, $13.00, Canada, $16.00. Other countries, $18.00. Single copies $1.25.

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Radio-Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

APRIL 1980 Vol. 51 No. 4

BUILD

39 **TRIGGERED OSCILLOSCOPE**
A 2-MHz bandwidth and a zero-baseline display for under $125. **Daniel Metzger and Dennis Perry**

47 **BACKYARD SATELLITE TV RECEIVER**
This concluding part describes how to recover the video and audio signals from the satellite signal and then display them on your TV set. **Robert B. Cooper, Jr.**

53 **PORTABLE ELECTRONIC ORGAN**
Learn to play a keyboard instrument on either one of the two inexpensive organs described. One plays melody, the other plays melody and chords. **I. Queen**

61 **3½ DIGIT DMM**
Specifically designed for accuracy and minimal cost, this DMM lets you select and add the features you need. **Carson Chen**

TECHNOLOGY

5 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

6 **APRIL NEWS AROUND THE WORLD**
Exclusive report on the technological developments around the world during just the month of April. **Martin Bradley Weinstein**

12 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry. **Robert B. Cooper, Jr.; Gary H. Arlen**

44 **SPEECH SYNTHESIZERS**
Part 2—A look at the hardware designed to talk back to you. **Martin Bradley Weinstein**

72 **HOBBY CORNER**
An inexpensive wide-bandwidth preamplifier with many applications on your workbench. **Earl "Doc" Savage, K4SDS**

77 **NEW IDEAS**
A winning circuit application from our readers.

AUDIO

56 **CAR STEREO STANDARDS**
The new standards and specifications to help you select car stereo equipment. **Len Feldman**

59 **R.E.A.L. SOUND LAB TESTS NIKKO EQUALIZER**
Nikko Audio model EQ-II graphic equalizer rates excellent.

VIDEO

65 **TROUBLESHOOTING BETA TRANSPORT MECHANISMS**
A look at the transport mechanism in Beta-type videocassette recorders and how to troubleshoot it. **Forest Belt**

69 **AFFORDABLE NTSC COLOR-BAR GENERATOR**
A new NTSC color-bar generator that is within reach of every service bench. **Jack Darr**

82 **SERVICE CLINIC**
How to locate faults in all-electronic tuners. **Jack Darr**

82 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

COMPUTERS

74 **COMPUTER CORNER**
How to interface a 7-segment display to a microprocessor. **J. Titus, P. Rony, D. Larsen and C. Titus**

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24 **Beckman Models Tech-300 and Tech-310 DMM's.**
24 **JVC Model HR-6700U Video Cassette Recorder.**
33 **Hitachi Model V-302 Dual Trace Oscilloscope.**
36 **The BASIC Programmer's Toolkit for PET Computers.**

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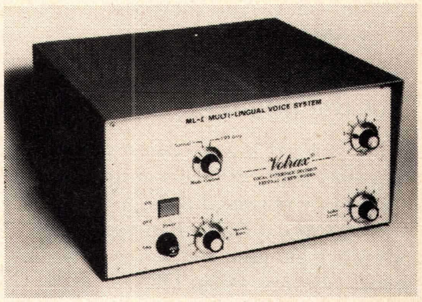
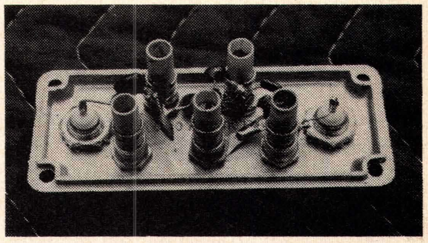
ON THE COVER

Even though it costs less than $125 to build, the triggered oscilloscope contains some rather nifty features. For example, a reference display of the zero volt DC level. To find out more and to get started building your own, turn to page 39.



MULTI-LINGUAL VOICE SYSTEM from Votrax can talk to you in seven languages. To find out what other speech synthesizer equipment is available, turn to page 44.



IF BANDPASS FILTER provides satellite TV receiver with the required selectivity. To find out the other missing components of the receiver, turn to page 47.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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MAY 1980 Vol. 51 No. 5

SPECIAL FEATURE

45 **ELECTRONIC DEVICES FOR SELF-IMPROVEMENT**
A look at how state-of-the-art electronics have combined with recent medical discoveries to help you master your mind and body's "involuntary" reactions. **David R. Wheeler**

62 **NEW USES FOR YOUR CAP METER**
If your capacitance meter is collecting dust, then you're not using it to its fullest advantage. Here's a look at some of its many uses besides testing capacitors.
Martin Bradley Weinstein

BUILD THIS

49 **PROFESSIONAL DRUM SYNTHESIZER**
Unique device provides many of the features only found in synthesizers costing several times more. **Steve Wood**

53 **TRIGGERED OSCILLOSCOPE**
Part 2—Final construction details for a scope with a 2-MHz bandwidth and a zero baseline display for under $125.
Daniel Metzger and Dennis Perry

57 **VERSATILE ANALOG INTERFACE**
When connected to your computer, this simple device along with the proper software can be used for a wide variety of interfacing applications, including joysticks. **John R. Hanson**

76 **WIDE-RANGE AUDIO GENERATOR**
Great addition for your test bench produces sine and square waves over the audio band from 10Hz to 50kHz.
Richard Schroeder

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

16 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry.
Gary H. Arlen

82 **NEW IDEAS**
A winning circuit application from our readers.

COMMUNICATIONS

60 **WARC-79**
Here are the results of the long-awaited World Administrative Radio Conference with an analysis of its expected impact.
Stanley Leinwoll

88 **COMMUNICATIONS CORNER**
What is frequency companding and how it can jam more channels into the RF spectrum. **Herb Friedman**

VIDEO

65 **TROUBLESHOOTING BETA TRANSPORT MECHANISMS**
How to troubleshoot the transport mechanism in Beta-type videocassette recorders and how to fix them. **Forest Belt**

68 **SERVICING COMMUNICATIONS EQUIPMENT**
Repair and installation of two-way radios can be an alternative field for service shops. **Greg Grambor**

AUDIO

72 **MORE ON SUPER CLASS-A AMPLIFIERS**
New amplifier design produces ultra-low distortion levels. Here's a look at the driver stages. **Len Feldman**

74 **R.E.A.L. SOUND LAB TESTS DENON CASSETTE DECK**
Denon model DR-750 cassette deck rates excellent.

COMPUTERS

70 **DIAL-UP COMPUTER SOFTWARE**
A look at the national software networks that your computer accesses via the telephone lines—what they offer and how to connect up. **Jules H. Gilder**

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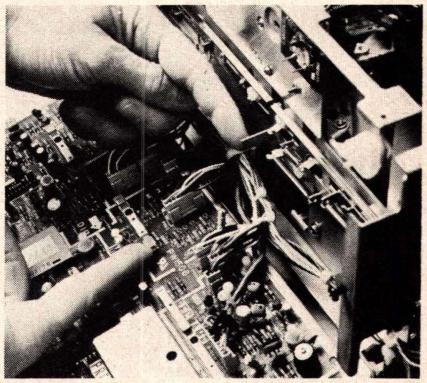
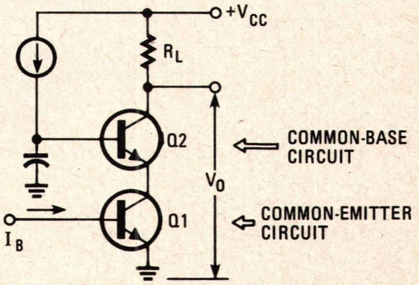
93 **Service Questions**

ON THE COVER

This professional drum synthesizer consists of four individual modules that combine to provide features found only on synthesizers costing several times more. A unique pressure-sensitive transducer mounted inside the practice pad lets you literally pound out a tune. Get started building your own today, the story starts on page 49.



IT LOOKS COMPLICATED, and in fact, it is! It's the transport mechanism of a Beta-type videocassette recorder. But don't let looks scare you off. To find out how to troubleshoot and fix it, turn to page 65.



CASCODED CONFIGURATION of a common-emitter and common-base amplifier stages provide ultra-low distortion. To find out how this circuit works, turn to page 72.

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JUNE 1980 Vol. 51 No. 6

SPECIAL FEATURE 43 **HISTORY OF TELEVISION**
A chronological look at the advances that made television a reality. **Kathy Goforth**

BUILD 47 **AUTOMOTIVE VOLTAGE REGULATOR**
Improved design overcomes many of the shortcomings of factory-installed units. **L. Steven Cheairs**

51 **SYNTHESIZED FUNCTION GENERATOR**
Phase-locked-loop technology results in improved performance. **Gary McClellan**

59 **PROFESSIONAL DRUM SYNTHESIZER**
Part 2—Final construction details. This unique device provides many of the features normally found on synthesizers costing several times more. **Steve Wood**

TECHNOLOGY 4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

26 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry. **Gary H. Arlen**

70 **NEW IDEAS**
A winning circuit application from our readers.

80 **HOBBY CORNER**
A 555-timer based control circuit that can be used in a wide variety of applications. **Earl "Doc" Savage, K4SDS**

RADIO 66 **INTERNATIONAL NUMBER STATIONS**
Secret coded messages are being broadcast internationally. Here's a look at when and where to listen in and what the messages may mean. **Robert B. Grove**

72 **COMMUNICATIONS CORNER**
A look at how an audio processor boosts receiver performance. **Herb Friedman**

AUDIO 63 **DIGITAL AUDIO FOR THE 1980's**
A look at PCM technology and its outlook for the 1980's. **Len Feldman**

VIDEO 68 **BACKYARD SATELLITE-TV RECEPTION**
A rundown of some of the misconceptions. **Fred Hopengarten**

78 **SERVICE CLINIC**
Conventional power-supply circuits that look very odd. **Jack Darr**

79 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

COMPUTERS 56 **HOW TO CONNECT AN A/D CONVERTER**
Here's how to interface your next microprocessor-based project to analog signals. **Joseph J. Carr**

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38 **Heathkit/Thomas TO-1860 Electronic Organ Kit**
39 **Lafayette BCR-101 General Coverage Receiver**

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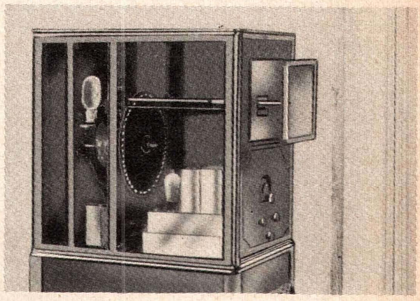
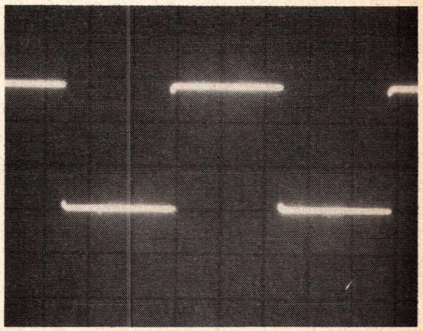
ON THE COVER

This unique function generator uses phase-locked-loop technology to overcome many of the shortcomings of commercially-available units. Frequency stability is supurb. Sine, square, and triangular waveforms are provided via a 50-ohm output jack. The generator also has a separate set of outputs to drive TTL loads.



TELEVISION—from the drawing board to a reality. Shown above is the Jenkins Projection Radiovisor, developed in 1931. For a look at the history of television, turn to page 43.



DIGITAL AUDIO for the 1980's. The squarewave response of Toshiba's PCM recorder shows the improved performance of this new audio technology. For the rest of the details, turn to page 63.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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JULY 1980 Vol. 51 No. 7

BUILD

43 **ENVIRONMENTAL CONTROL CENTER** Technology and Mother Nature work together to reduce home heating and cooling costs. **Tom Stults**

63 **HOME INTERCOM SYSTEM** Simple and inexpensive way to hear—and be heard—all through the house. **David J. Sweeney**

65 **SYNTHESIZED FUNCTION GENERATOR** Part 2—Complete construction details. A professional-quality tool for the experimenter or technician. **Gary McClellan**

TECHNOLOGY

4 **LOOKING AHEAD** Tomorrow's news today. **David Lachenbruch**

16 **SATELLITE TV NEWS** The latest happenings in an exciting new industry. **Gary H. Arlen**

55 **VMOS—A GIANT STEP TOWARD THE IDEAL** The closest thing yet to the "perfect" transistor. **Bill Roehr**

73 **NEW IDEAS** A winning circuit application from our readers.

74 **HOBBY CORNER** More about tide clocks, and other items. **Earl "Doc" Savage, K4SDS**

VIDEO

48 **COAX vs. TWIN-LEAD** Shielded cable is better than twin-lead... or is it? **James E. Kluge**

81 **SERVICE CLINIC** Oscilloscopes simplify troubleshooting. **Jack Darr**

82 **SERVICE QUESTIONS** R-E's Service Editor solves technicians' problems.

AUDIO

58 **DESIGNING SMALL SPEAKER SYSTEMS** Many factors must be weighed and balanced to obtain optimum performance. **Len Feldman**

70 **R.E.A.L. SOUND LAB TESTS AUDIO CONTROL CIO EQUALIZER/ANALYZER** Combination graphic equalizer and real-time analyzer rates excellent.

RADIO

78 **COMMUNICATIONS CORNER** The most comprehensive piece of test equipment we've seen yet. **Herb Friedman**

COMPUTERS

51 **CONNECT A D/A CONVERTER** Interfacing microprocessors to the analog world. **Joseph J. Carr**

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38 **Radio Shack Quick Printer II**

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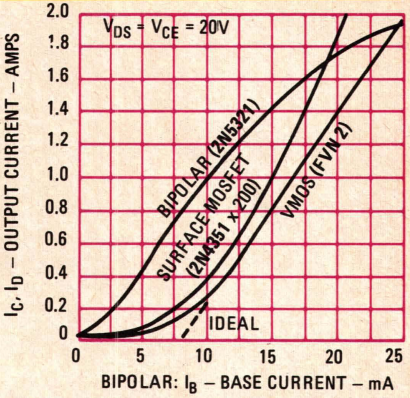
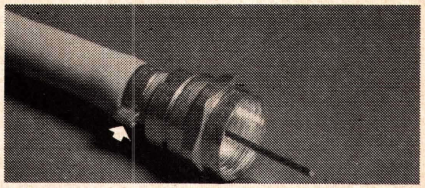
ON THE COVER

Sitting on the desk in front of the window is the thermostat portion of the Environmental Control System. This system connects to your heating, air conditioning and ventilating systems and controls their operation in accordance with inside and outside temperature, and humidity. Energy savings of up to 20% can be realized with this system. Get started building yours today. The construction details starts on page 43.



VMOS DEVICES have near ideal characteristics. For the complete story on VMOS, turn to page 55.



COAX VS. TWINLEAD for your TV antenna. Shown above is one of 9 steps in making ideal coaxial connections. For the other 8 steps and the full story, turn to page 48.

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AUGUST 1980 Vol. 51 No. 8

BUILD

37 UNICORN-I ROBOT
Part 1. Complete with manipulator arms and mobile base, you can build this robot for under $400. Various levels of control and intelligence are described, including an on-board computer. **James A. Gupton, Jr.**

42 RACEWAY VIDEOGAME
After you build this video game, you can pretend to be an Indy 500 race-car driver without ever leaving the comfort of your armchair. **L. Steven Cheairs**

46 6 AUDIO TEST ACCESSORIES
Construction details for 6 easy-to-build accessories for the audio test bench. Useful for troubleshooting or checking the performance of your hi-fi system. **Gary Stock**

54 $10 LOGIC PROBE
A necessary instrument for troubleshooting digital circuitry. **Fred Blechman**

TECHNOLOGY

4 LOOKING AHEAD
Tomorrow's news today. **David Lachenbruch**

16 SATELLITE TV NEWS
The latest happenings in an exciting new industry. **Gary H. Arlen**

49 PICTORIAL GUIDE TO VHS THREADING
A look at the threading mechanism inside the VHS videotape recorder. **Forest Belt**

66 HOBBY CORNER
A quick and easy way to make one-of-a-kind printed circuit boards. **Earl "Doc" Savage, K4SDS**

VIDEO

62 STEP-BY-STEP TV IF ALIGNMENT
How to align the video-IF stages of a TV receiver. **Jack Darr**

74 SERVICE CLINIC
Hints for catching the touchy intermittent. **Jack Darr**

75 SERVICE QUESTIONS
R-E's Service Editor solves technicians' problems.

AUDIO

56 SERVO-CONTROLLED PICK-UP ARM
New JVC turntable includes a unique pick-up arm that electronically adjusts the damping characteristics to match virtually any cartridge. **Len Feldman**

RADIO

59 TUNING IN WORLDWIDE SW STATIONS
The RF spectrum is chock full of interesting communications, including INTERPOL, the Strategic Air Command, NORAD, even spies. Here's a look at what's out there and how to tune them in. **Robert Grove**

70 COMMUNICATIONS CORNER
A look at a remote-controlled coax switch for switching bands easily. **Herb Friedman**

EQUIPMENT REPORTS

26 Leader LSG-16 RF Signal Generator
32 MFJ Enterprises LSP-520BX Speech Processor
34 Hickok 240 Video Pattern Generator

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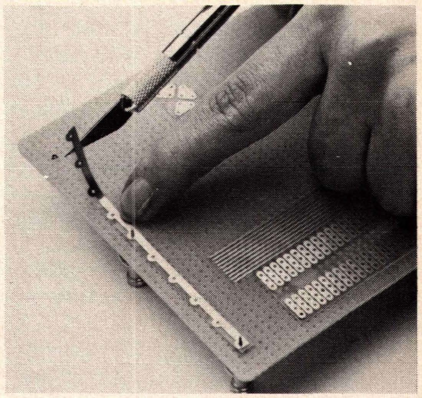
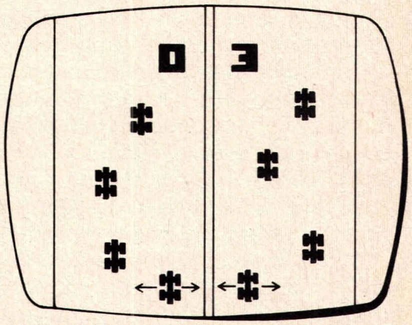
ON THE COVER

Finally, the construction article you've all been asking for: An 8-part series describing a full blown, fully mobile robot complete with manipulator arms. Options include remote control operation, operation via external computer via the remote-control link and an on-board computer. Suggestions are given for adding senses such as sight and feel. The basic robot, minus the options, can be built for under $400. Get started building yours today. Complete details start on page 37.



A QUICK AND EASY way to make one-of-a-kind printed circuit boards. The details start on page 66.



RACEWAY VIDEO GAME you can build lets you pretend to be a *Indy 500* race-car driver without ever leaving the comfort of your armchair. Construction details start on page 42.

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SEPTEMBER 1980 Vol. 51 No. 9

SPECIAL FEATURE

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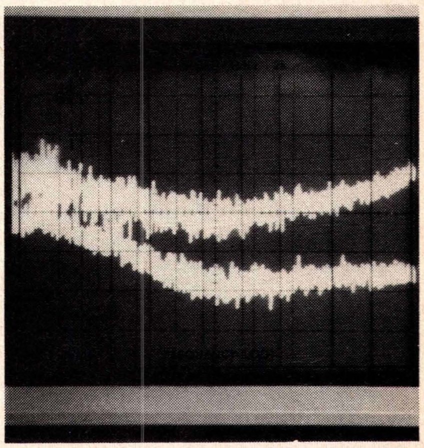
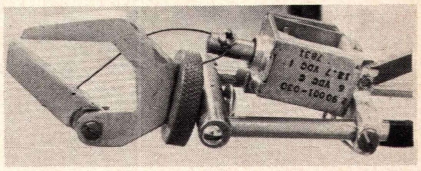
ON THE COVER

You can turn on and off lamps and appliances without ever leaving your armchair with BSR's System X-10. To install the system, you simply plug the various modules into existing AC wall outlets. The system features a hand-held ultrasonic remote control unit and a programmable timer. For a look at the circuitry and how the system works, turn to page 47.



NEW NOISE REDUCTION SYSTEM for tape recorders provides 18-dB more noise reduction than Dolby B. For the complete details, turn to page 61.



HANDS FOR THE UNICORN-1 ROBOT are solenoid activated. For details on how to assemble the manipulator arms and hands, turn to page 55.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELCTRONICS

Electronics publishers since 1908

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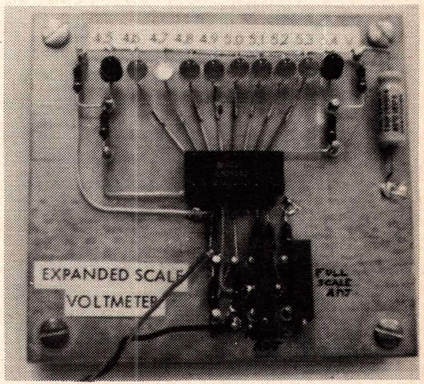
A synthesized pulse generator that goes from 0.1 Hz to 1 MHz. All CMOS design, this device is ideal for putting logic circuits through their paces and for use as an AF and RF signal generator. Synthesizer allows exact selection of frequency and guarantees repeatability. Construction details begin on page 87.

SPECIAL COMPUTER SECTION covers recent developments in the personal computer field. Find out what's for you, starting on page 45.



LED DISPLAYS are showing up in more and more designs. Learn how to design your own on page 96.

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61 **BUILD YOUR OWN ROBOT**
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65 **A BYTE OF POWER AC CONTROLLER**
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A winning circuit application from our readers.

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70 **TV INTERFERENCE**
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101 **SERVICE CLINIC**
A look at several useful hints from our mailbag. **Jack Darr**

102 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

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73 **HOW TO INTERFACE SYSTEM COMPONENTS**
If you're the owner of a stereo system using separate components, here's how to put them all together. **Len Feldman**

76 **R.E.A.L. SOUND LAB TESTS SHURE M97HE PHONO CARTRIDGE**
This medium/high priced cartridge rates superb.

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90 **COMMUNICATIONS CORNER**
Why pay extra for features and performance we may never use? **Herb Friedman**

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58 **USE A PIA FOR SIMPLER μP-BASED CIRCUITS**
Your next microprocessor-based project should include a PIA for simpler circuitry. **David R. Anderson**

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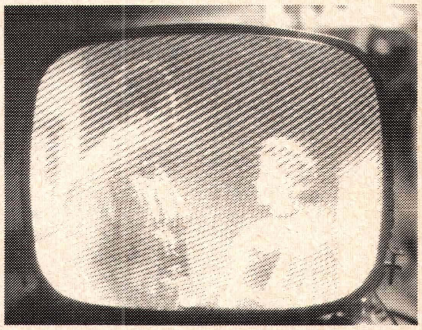
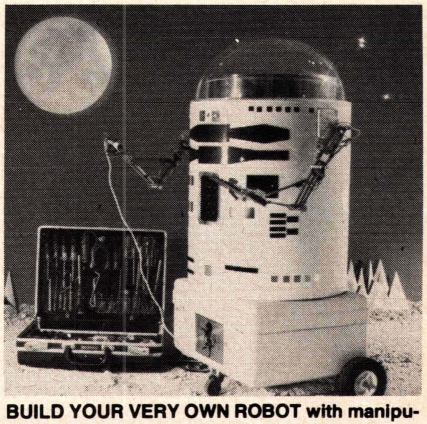
ON THE COVER

The experimenter's circuit design station will make a great addition to your workbench. Use it to prototype and debug your circuits before hardwiring them. The station is battery powered and includes a two-phase clock oscillator, LED status indicators, debounced switches, and a solderless breadboard. Get started building yours today. Construction details start on page 47.



TV INTERFERENCE can be more than just annoying. For a look at the different types and what you can do to eliminate them, turn to page 70.



BUILD YOUR VERY OWN ROBOT with manipulator arms and mobile base. Multi-part construction series continues on page 61.

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JANUARY 1981 Vol. 52 No. 1

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45 **ELECTRONICS IN YOUR NEXT CAR**
Looking under the hood will reveal advanced engine-control systems, including microprocessors. Here's a look at those new systems and how they function.
Martin Bradley Weinstein

56 **UNIVERSAL COUNTERS/TIMERS**
A new breed of test instrument for the technician and experimentor. Here's how they're used and what's available on the market. **Martin Bradley Weinstein**

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Adaptor connects to the video-detector output inside your TV to descramble over-the-air pay-TV signals.
Ray Pichulo

49 **COMPUTER/TV INTERFACE**
Adaptor lets you modify your TV set for use as a video monitor. **David E. Cartier**

51 **UNICORN-I ROBOT**
Modifying the arms to provide a twist-of-the-wrist function plus adding LED motor-direction indicators.
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The latest happenings in an exciting new industry.
Gary H. Arlen

64 **MAJORITY LOGIC**
Majority-logic IC's can make designing some digital circuits easier. Here's how those IC's work and how you can use them in your digital circuits.
John E. Cunningham

68 **HOBBY CORNER**
Another easy way to make circuit boards.
Earl "Doc" Savage, K4SDS

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78 **SERVICE CLINIC**
Catastrophic failures in solid-state circuits. **Jack Darr**

79 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

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60 **NOISE-REDUCTION TECHNIQUES**
A look at the various devices available for reducing the noise level in your high-fidelity system.
Joseph M. Gorin

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ON THE COVER

Over-the-air pay-TV stations are sprouting up across the country. Those stations broadcast encoded recently-released movies. An adapter connected internally to your TV set will enable you to decode those over-the-air broadcasts. The lower right-hand corner of the cover shows what the encoded broadcast looks like. The upper left-hand corner of the photo shows Bo Derek in a scene from the recent movie "10"*.

For a look at how the over-the-air pay-TV encoding system works, and how you can build your own decoder, turn to page 41.

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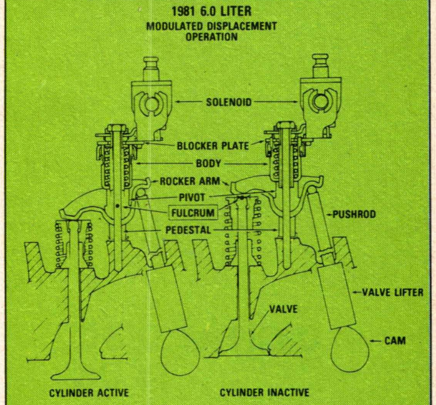
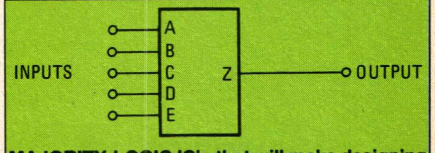


YOUR NEXT CAR. A look under the hood and how microprocessors will be controlling the engine in the next generation of U.S. cars.



MAJORITY-LOGIC IC's that will make designing digital circuits easier are available. To find out what majority logic is, and how you can use it, turn to page 64.

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FEBRUARY 1981 VOL. 52 No. 2

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Duplicating Tesla's high-voltage experiments in hopes of finding an answer to nuclear fusion. **Robert Golka**

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51 **PAY-TV DECODER**
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59 **UNICORN-1 ROBOT**
Part 7—Construction details for an interface board that will permit motor control via remote control or an on-board computer. **James A. Gupton, Jr.**

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Add-on accessory for your DMM extends resistance measurements down to .0001 ohms. **J.T. Cataldo**

74 **PROM PROGRAMMER**
Program your own PROM's on your workbench with this inexpensive device. **T. E. LeVere**

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The latest happenings in an exciting new industry. **Gary H. Arlen**

80 **HOBBY CORNER**
Circuits solutions for an all-electronic judge for the Pinewood Derby. **Earl "Doc" Savage, K4SDS**

88 **NEW IDEAS**
A prize-winning application from a reader.

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50 **NEW DIMENSION IN TV SOUND**
Stereo TV sound may not be here yet, but new circuitry from RCA offers the next best thing. **Karl Savon**

71 **ANSWERS TO 10 HOME-VIDEO QUESTIONS**
Here are the answers to the 10 most often asked questions about videotape recorders. **Len Feldman**

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If there's a capacitor that keeps burning up in your TV set, here may be the reason why. **Jack Darr**

94 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

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64 **NOISE-REDUCTION TECHNIQUES**
Part 2—A look at today's devices that are available for reducing the noise in your hi-fi system. **Joseph M. Gorin**

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86 **COMMUNICATIONS CORNER**
Things are really different outside the big cities. **Herb Friedman**

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ON THE COVER

The spectacular display of lightning is being produced by the largest Tesla coil in the United States. Erected inside an airplane hanger at Wendover Air Force base, it is a duplicate of Tesla's original coil, and is being used in a search for an answer to nuclear fusion.

ANNUAL INDEX JANUARY—DECEMBER

1980

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size) to:*

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Annual Index
45 East 17th Street
New York, NY 10003

Any requests postmarked on or before April 30 are free. After that date there is a 25¢ fee. Questions and comments about anything other than the Index that are included with your request cannot be handled. Send them separately to our Editorial Offices.

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MARCH 1981 Vol. 52 No. 3

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49 ELECTRONICS IN YOUR NEXT CAR
Microprocessors now make it possible for your car to tell you what's wrong with it. **Martin Bradley Weinstein**

BUILD THIS

41 AUDIO SIGNAL RESTORATION UNIT
Hear your records and tapes as you've never heard them before. **Joseph M. Gorin**

60 DO-NOTHING BOX
Does "nothing" like you've never seen it done yet. **Noel Nyman**

63 UNICORN-1 ROBOT
The first step on the road to radio control.
James A. Gupton, Jr.

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Tomorrow's news today. **David Lachenbruch**

16 SATELLITE TV NEWS
The latest happenings in an exciting new industry.
Gary H. Arlen

55 IDENTIFYING UNMARKED IC'S
Every IC has a "signature" that sets it apart from other types. An ohmmeter and a piece of paper will let you classify the contents of your junk box. **Kenneth H. Recorr**

70 HOBBY CORNER
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67 VIDEODISC SIGNAL PROCESSING
How laser videodisc signals are encoded and decoded.
Len Feldman

84 SERVICE CLINIC
About sweep-circuit timing problems. **Jack Darr**

86 SERVICE QUESTIONS
R-E's Service Editor solves technicians' problems.

RADIO

45 SHORT WAVE JAMMING DEVELOPMENTS
International broadcasts are still frequently plagued by jamming. Here's what's happening now. **Stanley Leinwoll**

76 COMMUNICATIONS CORNER
How to suppress harmonic radiations effectively.
Herb Friedman

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52 ALTERNATE MEANS OF DISTORTION REDUCTION
A new system for minimizing distortion without having to resort to negative feedback. **Len Feldman**

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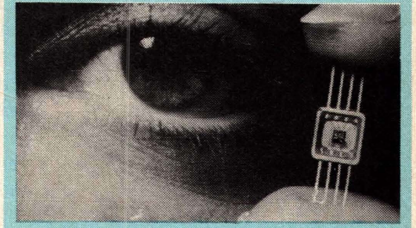
ON THE COVER

The ASRU (*A*udio *S*ignal *R*estoration *U*nit) is a combination noise-reduction and signal-expander device that offers features not even found on some commercial units. Build one yourself and hear things from your records and tapes that you never heard before. The first part of this project begins on page 41.

FIND OUT HOW laser videodisc players handle the complex signals inscribed on those shiny platters. The story starts on page 67.



UNMARKED IC's can be a bargain. Learn how to find out what's inside those plain black packages on page 55.

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APRIL 1981 Vol. 52 No. 4

SPECIAL FEATURE

47 **VIDEODISC 1981**
Learn what you can expect from the first generation of videodisc players. **Chester H. Lawrence**

BUILD THIS

52 **COMPUTER-*SELECTRIC* INTERFACE**
An easy way to use an IBM *Selectric* terminal/printer for output from your computer. **E.G. Brooner**

65 **UNICORN-1 ROBOT**
Finishing up the conversion to radio control.
James A. Gupton, Jr.

70 **AUDIO-SIGNAL RESTORATION UNIT**
Build this and "expand" your listening pleasure.
Joseph M. Gorin

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4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

12 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry.
Gary H. Arlen

56 **PROGRAMMABLE SOUND GENERATOR**
A single IC that, under computer control, produces sound effects and even three-part harmony.
Bonaventura Antony Paturzo

82 **HOBBY CORNER**
Remote volume control for your TV set.
Earl "Doc" Savage, K4SDS

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79 **TRONICS 2000**
A nationwide home-electronics service network.
Richard W. Lay

100 **SERVICE CLINIC**
About phase-controlled power supplies. **Jack Darr**

101 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

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62 **MORSE CODE & RTTY DECODERS**
New devices make it effortless for you to decipher transmissions made using these modes. **Danny Goodman**

90 **COMMUNICATIONS CORNER**
Cordless telephones—how they work. **Herb Friedman**

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75 **BIG BASS FROM SMALL SPEAKERS**
Miniature speakers produce more than their share of bass with an electronic assist. **Len Feldman**

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26 **Keithley Model 130 DMM**
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34 **Heath Model VF-7401 Scanning Transceiver**
35 **B&K Precision Model 1520 20-MHz Oscilloscope**
37 **Wilson WV-1A Four-Band Vertical Antenna**
42 **Non-Linear Systems Model MLB-1 Logic Probe**
44 **Drake R7 General Coverage Receiver**

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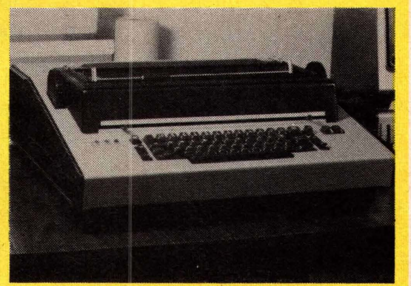
ON THE COVER

Within a few months, three different videodisc systems will be competing in the marketplace. Each has its own advantages...and drawbacks. Find out how the systems compare with one another beginning on page 47.



INTERFACING AN IBM *SELECTRIC* mechanism to your computer doesn't have to be complicated. A four-IC solution begins on page 52.

RCA·ZENITH·GE·SONY·PIONEER·PANASONIC·SANSUI·SHARP
AKAI·JVC·SANYO·TEAC·MAGNAVOX·HITACHI·CRAIG·QUASAR
WELCOME TO
tronics 2000
SERVICING HOME ELECTRONICS NATIONWIDE

ELECTRONIC SERVICING is entering a new era. Discover how a small shop can provide the services of a large organization. Story starts on page 79.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

MAY 1981 Vol. 52 No. 5

SPECIAL FEATURES

45 **LEARNING ABOUT MICROPROCESSORS**
To learn how microprocessors work and how to program them, hands-on experience is the proven method. Single board assembly-language computers provide the means. **Jorma Hyypia**

49 **INSIDE RCA's VIDEODISC PLAYER**
Here's a look at how RCA's videodisc player works and how the signals are processed. **Chester H. Lawrence.**

BUILD THIS

53 **UNICORN-1 ROBOT—ADDING COMPUTER CONTROL**
A look at the hardware and programming requirements needed to add computer control. **Chester H. Lawrence.**

59 **LED VU METER FOR YOUR HI-FI**
Here's an all-electronic digital VU meter that you can add to your hi-fi system. **Bradley Albing**

64 **COMPUTER-TO-SELECTRIC INTERFACE**
Part 2 - An inexpensive way to use an IBM *Selectric* typewriter as a hard copy printer for your computer. **E. G. Brooner**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

16 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry. **Gary H. Arlen**

76 **HOBBY CORNER**
Negative ion generators—what they're all about. **Earl "Doc" Savage, K4SDS**

84 **NEW IDEAS**
A prize-winning application from a reader.

VIDEO

56 **HOME VIDEO UPDATE**
A look at the video innovations from Japan, most of which will be available here soon. **Leonard Feldman**

86 **SERVICE CLINIC**
If all else fails, look for a leaky transistor. **Jack Darr**

88 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

RADIO

67 **PIRATE BROADCAST STATIONS**
They're unlicensed and illegal, but they can provide an interesting alternative to the standard broadcast fare. **Robert B. Grove**

AUDIO

70 **NEW DOLBY NOISE-REDUCTION SYSTEM**
Dolby's new system provides 20dB of noise reduction. Here's how it works. **Leonard Feldman**

EQUIPMENT REPORTS

32 **Global Specialties 2001 Function Generator**
34 **Sencore Model DVM-56 Microranger DMM**
36 **Alliance Model HD-73 Antenna Rotator**
42 **Radio Shack Metal Detector**

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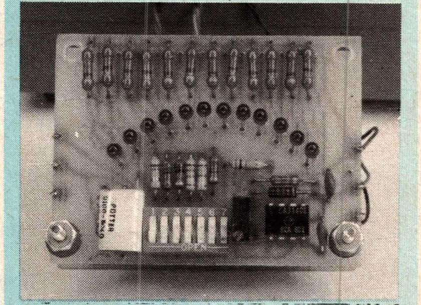
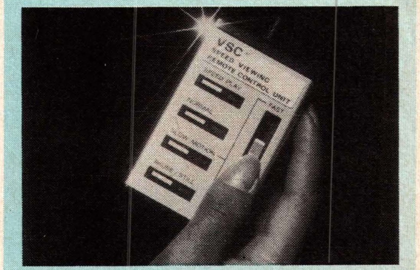
ON THE COVER

To understand how computers and microprocessor-based equipment works, it is necessary to understand how microprocessors work and how they're programmed. This month, we evaluate several single-board computers and the supplied documentation to determine how effective each one is as a learning tool. The story starts on page 45.



ADD AN LED DIGITAL VU meter to your hi-fi system for precise recording. Construction details start on page 59.



SPEED VIEWING allows you to listen to the sound while the VCR is scanning the tape. For this and other video innovations being introduced in Japan, turn to page 56.

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Radio-Electronics
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS
Electronics publishers since 1908
JUNE 1981 Vol. 52 No. 6

SPECIAL FEATURE

64 **INSIDE RCA'S VIDEODISC PLAYER**
How the CED system processes the audio portion of the signal. **Chester H. Lawrence**

BUILD THIS

39 **$60 MODEM**
Give your computer a telephone interface. There's a lot waiting for it at the other end of the line. **Robert Ward**

47 **LUMITRON-4 LIGHT SEQUENCER**
A four-channel light controller that will put many commercial disco installations to shame. **David L. Holmes**

57 **UNICORN-1 ROBOT**
Give your robot the senses of sight and touch. **James A. Gupton, Jr.**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

16 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry. **Gary H. Arlen**

43 **SOLID-STATE MICROWAVE DEVICES**
Semiconductors that operate in the gigaherz range are now available. Here's how they operate. **Joseph J. Carr**

68 **HOBBY CORNER**
A new self-study course. **Earl "Doc" Savage, K4SDS**

COMPUTERS

61 **COMPUTER SPEECH-RECOGNITION**
What's involved in getting computers to understand the spoken word. **Martin Bradley Weinstein**

VIDEO

54 **CHOOSING THE RIGHT VIDEOTAPE**
All videotapes are not the same. Here's what to look for when choosing one for your recorder. **Len Feldman**

82 **SERVICE CLINIC**
An open mind is a valuable tool. **Jack Darr**

83 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

RADIO

74 **COMMUNICATIONS CORNER**
More about cordless phones. **Herb Friedman**

AUDIO

51 **NEW GENERATION OF STEREO HEADPHONES**
How those lightweight headphones can produce such amazing sound. **Len Feldman**

EQUIPMENT REPORTS

32 **Triplett Model 7000 Frequency Counter**
33 **Hickock Model MX 333 Universal DMM**
34 **Radio Shack Model 42-3019 Sound-Level Meter**
35 **McKay Dymek Model 33C General Coverage Communications Receiver**
36 **Moody Tools Model MMK6 Master Kit**

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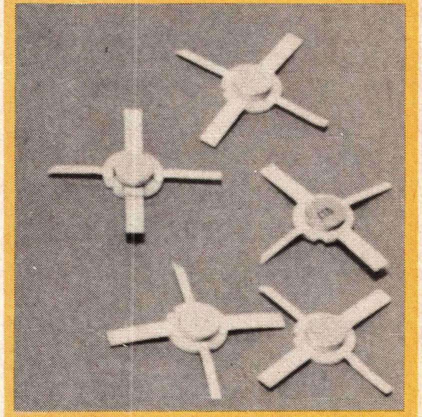
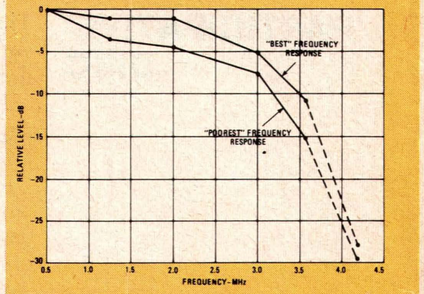
ON THE COVER

There are many things your computer can do when it can communicate with other computers. This modem—that you can build for under $60—will allow your computer to use the telephone to interact with computers all over the country. The project begins on page 39.



SOLID-STATE MICROWAVE DEVICES are vital to our efficient use of the upper end of the RF spectrum. A history of these devices, along with a description of how they function, starts on page 43.



A FREQUENTLY OVERLOOKED part of a videotape system is the tape itself. To find out what qualities you should be looking for, turn to page 54.

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Electronics publishers since 1908

JULY 1981 Vol. 52 No. 7

SPECIAL FEATURE

31 **CORDLESS TELEPHONES**
A component-by-component look at how the circuits work.
Robert F. Scott

BUILD THIS

36 **NEGATIVE ION GENERATOR**
Negatively-charged oxygen is claimed to provide many benefits. Here's your chance to find out for yourself.
Ronald E. Pyle

45 **$60 MODEM**
The second part of this article winds up the construction phase of the project and introduces the software. **Robert Ward**

56 **LUMITRON-4 LIGHT SEQUENCER**
Final construction and checkout and a fascinating light display. **David L. Holmes**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

14 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry.
Gary H. Arlen

60 **BURR-BROWN APPLICATION NOTE**
A simple comparator with variable hysteresis.

62 **HOBBY CORNER**
In and out of the mailbag. **Earl "Doc" Savage, K4SDS**

73 **NEW IDEAS**
A prize-winning application from a reader.

VIDEO

39 **BETTER UHF-TV RECEPTION**
There are a lot of worthwhile programs on UHF, and more to come with the new FCC ruling. Here's a survey of antenna systems and accessories to help you get the best reception.
Dennis C. Brown

75 **SERVICE CLINIC**
Overload-protection circuits. **Jack Darr**

RADIO

69 **COMMUNICATIONS CORNER**
How switching diodes operate. **Herb Friedman**

AUDIO

49 **FEEDFORWARD AMPLIFIER**
A new distortion-reduction technique that revives an old concept. **Len Feldman**

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20 **Nevom Model CM-100 Wireless Microphone**
21 **Hamtronics Out-of-Band Converters**
21 **Sony Model ICF-2001 Receiver**
22 **Osborne/McGraw-Hill: Some Common BASIC Programs**

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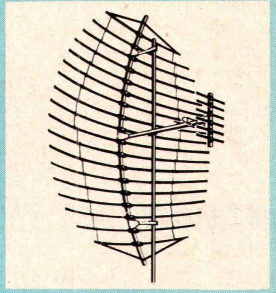
ON THE COVER

Cordless telephones offer all the conveniences—and then some—of the wired kind. For a detailed description of what they have to offer and how they work, turn to page 31.

WE HAVE BEEN DELUGED by requests for plans for a negative ion generator. At long last we have one for you. The project starts on page 36.



UHF-TV PROGRAMS OFFER a lot and would have a larger audience if the stations could be received better. The survey starting on page 39 can help you pull in their sometimes-elusive signals.

Due to space restrictions, the second part of the article on Solid-State Microwave Devices, scheduled to appear this month, will appear in the August issue.

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AUGUST 1981 Vol. 52 No. 8

SPECIAL FEATURE

41 **THE INCREDIBLE SHRINKING IC**
A short history of integrated circuits, and a look at their future. **Bonaventura Antony Paturzo**

BUILD THIS

45 **SATELLITE TV ANTENNA**
The 8-Ball—a satellite TV antenna you can build for under $750. **H.D. McCullough**

49 **SYNTHESIZED RF GENERATOR**
The Programma-2 covers a range of 300 kHz to 30 MHz and costs about $3100 less than its commercial counterparts. **Gary McClellan**

53 **ELECTRONIC MUSICAL HORN**
Don't blow your horn in traffic—*play it!*
Fred Blechman and David McDonald

57 **$60 MODEM**
Part 3—The conclusion of this article presents the software your computer will need to use the modem. **Robert Ward.**

64 **UHF PRESCALER**
Extend the range of your frequency counter up to 650 MHz. **Bill Owen**

TECHNOLOGY

4 **LOOKING AHEAD**
Tomorrow's news today. **David Lachenbruch**

22 **SATELLITE TV NEWS**
The latest happenings in an exciting new industry.
Gary H. Arlen

61 **SOLID-STATE MICROWAVE DEVICES**
How semiconductors can be made to oscillate in the gigahertz (1000-MHz) range. **Joseph J. Carr**

70 **HOBBY CORNER**
Some answers, some questions, and some useful information. **Earl "Doc" Savage, K4SDS**

72 **NEW IDEAS**
A prize-winning application from a reader.

VIDEO

73 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

AUDIO

67 **DIGITAL AUDIO FROM YOUR VCR**
At last you can do digital recording at home. Here's a description of how audio information is stored in a "video" format. **Leonard Feldman**

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30 **BBC-Metrawatt-Goerz Model MA1H VOM**
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31 **Radio Shack Model PRO-2002 Programmable Scanner**
32 **Kantronics Mini-Reader Morse Code and RTTY Decoder**

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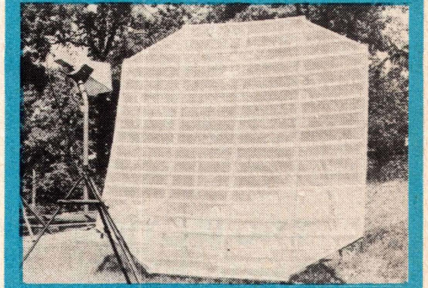
ON THE COVER

The first integrated circuit made its appearance 20 years ago. It held four transistors. Today, devices containing well over 50,000 transistors are available and IC's with several hundred thousand transistors on a single silicon chip are in the planning stage. Learn where we've been and where we're headed. The story starts on page 41.



ALTHOUGH PRICES are slowing coming down, satellite TV antennas still represent a substantial investment. You can build the 8-Ball for under $750, using readily available materials. Plans for this antenna begin on page 45.

DIGITAL AUDIO RECORDING is now available to anyone owning a VCR. Turn to page 67 for a detailed explanation of the method involved and the standards that have been established for this technique.

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Radio-Electronics
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS
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OCTOBER 1981 Vol. 52 No. 10

SPECIAL SECTION

51 **YOUR OWN COMPUTER: What You Should Know Before You Buy. Scott Parker**
54 **What to Look for in a Personal Computer**
61 **Floppy Disks Add Versatility**
71 **All About Printers**
78 **Modems—Computing via Telephone**
83 **Setting Up a System**

BUILD THIS

45 **HI-FI ANALOG REVERB SYSTEM**
Part 2. Finishing up this audio-enhancement device that adds ambience to your listening room. **Carl Sawtell**

48 **SATELLITE TV ANTENNA**
Part 3. How to install and aim the 8-Ball spherical TVRO antenna. **H.D. McCullough**

TECHNOLOGY

4 **VIDEO ELECTRONICS**
Tomorrow's news and products in this quickly changing industry. **David Lachenbruch**

12 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary Arlen**

94 **HOBBY CORNER**
Seven-segment LED's are for more than numbers. **Earl "Doc" Savage, K4SDS**

102 **NEW IDEAS**
An RF preamp for frequency counters.

COMPUTERS

103 **COMPUTER CORNER**
An introduction to computer applications. **Les Spindle**

VIDEO

39 **POCKET TV**
Recent developments in flat-screen display technology will soon put a *thin* portable TV in your pocket. **Danny Goodman**

108 **SERVICE CLINIC**
Using sweep alignment-generators. **Jack Darr**

110 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

AUDIO

90 **DYNAMIC NOISE REDUCTION**
How noise in non-encoded recorded material can be reduced. **Len Feldman**

RADIO

100 **COMMUNICATIONS CORNER**
Microprocessors...for better and worse. **Herb Friedman**

EQUIPMENT REPORTS

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26 **Grove Enterprises Scanner Beam Antenna**
28 **Macrotronics Models A4P and A8P Atari Printer Interfaces**
30 **Archer Telephone Recording Control**
32 **A.W. Sperry Model EZ 6100 DMM**

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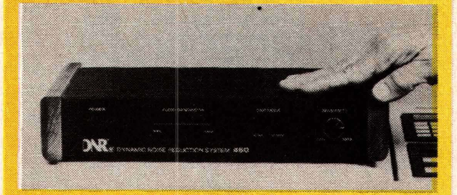
ON THE COVER

Flat-screen displays to make truly-portable, or "skinny" large-screen, TV's have been long awaited. Now, not one, but *two,* totally different means for achieving that goal have been demonstrated in working prototypes. The story of how those displays function starts on page 39.

SPECIAL COMPUTER SECTION explains what to look for in setting up a system for home or business use. The section begins on page 51.



MANY FINE RECORDINGS have been made without using noise-reduction techniques. A dynamic noise-reduction system can improve their sound. Find out how the process works starting on page 90.

Due to lack of space in this issue, Part 3 of the Programma-2 RF generator project will appear next month. We apologize for any inconvenience that may cause.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

NOVEMBER 1981 Vol. 52 No. 11

SPECIAL FEATURE

43 **VIDEOTEX**
How your TV will be able to supply you with all the information you need, when you need it. **Richard Larratt**

BUILD THIS

47 **LOW FREQUENCY FILTER**
Eliminate the effects of annoying low-frequency record "noise" with this simple circuit. **Joseph M. Gorin**

52 **EXPANDED SCALE VOLTMETER**
Here's a way for you to add super accuracy to your analog voltmeter. **T.J. Byers**

66 **SYNTHESIZED RF GENERATOR**
Part 3. How to complete, calibrate and use the Programma-2. **Gary McClellan**

TECHNOLOGY

4 **HOME ELECTRONICS**
Tomorrow's news and products in this quickly changing industry. **David Lachenbruch**

22 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary Arlen**

57 **ELECTRONIC TEMPERATURE MEASUREMENT**
What you need to know to build your own electronic thermometers. **Joseph J. Carr**

60 **SUPERSCOPE'S PIANOCORDER**
The player piano isn't dead—it's now electronic! **Warren Baker**

78 **HOBBY CORNER**
Remote weather-sensing instruments. **Earl "Doc" Savage, K4SDS**

90 **NEW IDEAS**
A battery saver for your car.

COMPUTERS

82 **COMPUTER CORNER**
Looking for a computer. **Kathy Tekawa**

VIDEO

72 **ONE VCR—MULTIPLE TV SETS**
How to use an MATV system to distribute programs from your VCR. **James E. Kluge**

92 **SERVICE CLINIC**
New shutdown circuits. **Jack Darr**

93 **SERVICE QUESTIONS**
R-E's Service Editor solves technician's problems.

AUDIO

63 **CBS' *CX* NOISE-REDUCTION SYSTEM**
How CBS produces companded records that can be played with or without a decoder. **Len Feldman**

EQUIPMENT REPORTS

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ON THE COVER

Television has already revolutionized the way we live. A second TV revolution is now under way with the introduction of videotex. Videotex will allow you to use your TV set to receive information on almost any subject you desire—news of all sorts, local special events, and even restaurant menus. In addition, it will permit you to transact much of your personal business—shopping, banking, etc.—from home. For a look at what's in store, turn to page 43.

phase linear
MODEL 220
TAPE MONITOR
DECODE
CBS CX DECODER
SOURCE
BYPASS

VIRTUALLY ALL STEREO records contain very-low-frequency signals that can be annoying to listen to and, potentially, can damage your sound system. A low-frequency filter will remove those signals, and plans for such a device begin on page 47.

SOMETIMES IT'S DESIRABLE to connect several TV sets to the same VCR. If you have a master-antenna setup, you can use it for that purpose. Several methods for taking advantage of your MATV facilities are described, starting on page 72.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, N.Y. and additional mailing offices. One-year subscription rate: U.S.A. and U.S. possessions, $13.00. Canada, $16.00. Other countries, $20.50. (Cash orders only, payable in U.S.A. currency.) Single copies $1.25. Printed in U.S.A.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

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join in sending
holiday greetings and
our best wishes for
a happy new year

ON THE COVER

CBS's new CX noise-reduction system for records is the latest happening in hi-fi—and the system works! Build our CX decoder and take advantage of the new CX records. They're available now and more are being introduced every day. Turn to page 43.

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A completely self-contained PROM programmer for storing your programs in reusable 2716 EPROM's. This project is a must for experimenting with microprocessors and designing microprocessor based projects. Construction details start on page 45.

ANNUAL INDEX JANUARY—DECEMBER

1981

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size) to:*

Radio-Electronics
Annual Index
45 East 17th Street
New York, NY 10003

Any requests postmarked on or before April 30 are free. After that date there is a 50¢ fee. Questions and comments about anything other than the Index that are included with your request cannot be handled. Send them separately to our Editorial Offices.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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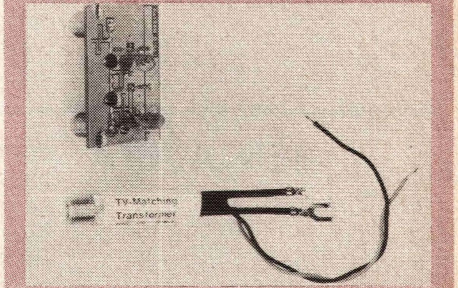
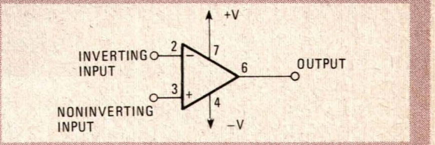
So far, the only way you could hear real digital sound reproduced on your own equipment was to invest in a $3000 PCM attachment for your VCR. Shortly, though, digital audio, using your existing amplifier and speakers, will be available for about the cost of a good turntable. New techniques—particularly in the area of laser scanning—will put 60 minutes of ultra-high-fidelity audio on one side of a disc you can hold in the palm of your hand. To find out what's in store, and how it works, turn to page 39.



GOOD UHF TELEVISION RECEPTION has always been more difficult to get than VHF. Part of the solution lies in a good antenna-system. An antenna-mounted preamplifier can also help. A preamp you can build that offers 25-dB of gain is described starting on page 59.



OPERATIONAL AMPLIFIERS (OP-AMPS) are an important—but frequently misunderstood—member of the IC family. Learn what makes them so useful and how to work with them beginning on page 54.

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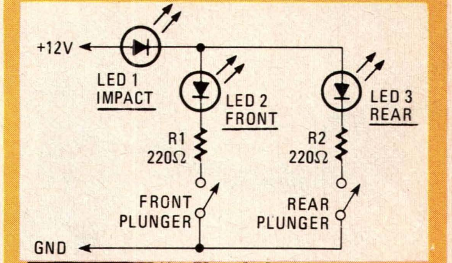
The video titler is a graphics and alphanumeric character generator for the amateur videophile. Connect it to your VCR and video camera setup and use it to add titles to your home video movies. Get started today building this microprocessor-based video accessory. The story starts on page 39.



A SIMPLE COLLISION DETECTOR is just one of six easy-to-build projects for your car that were designed especially for April 1. Turn to page 46.

IBM's PERSONAL COMPUTER is just one of the many hardware systems covered in this month's special section. Both hardware and software are covered. Turn to page 51.

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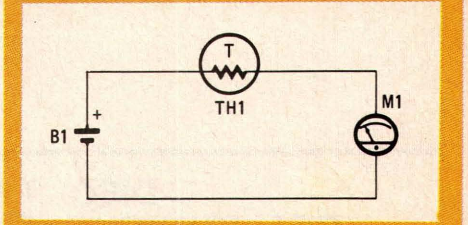
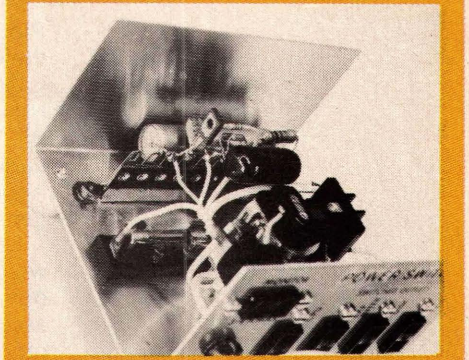
Build this high-quality satellite TV receiver for under $500. Add a satellite TV antenna and LNA for a complete TV earth station. The kit comes with a pre-aligned IF strip and LNA power supply. Get started building your satellite receiver today. Turn to page 49.



HOW TO DESIGN analog circuits is a new 11-part series on analog components and how to apply them. This month, thermistors and varistors are covered. The story starts on page 57.



AUTOMATIC POWER SWITCHER solves the problem of having to turn on multiple power switches in your hi-fi or computer system. Throw one switch and the power switcher does the rest automatically. Construction starts on page 54.

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Part 2. Complete construction plans for this under-$500 device. **David Becker**

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ON THE COVER

A lot has been written recently about "sonic imagers." Those devices modify the sound reproduced by your stereo system so that it appears to come from outside of, behind, and even in front of your two speakers—in fact, the speakers almost seem to disappear. To find out how you can build your own stereo image expander for under $100, turn to page 45.

STEREO AND BILINGUAL programs are regularly broadcast on Japanese and German TV. The German system uses a technique quite different from the former, and it may be better. Learn how it works, starting on page 58.

HOW ACCURATE is your test equipment? You can check out volt- and ohmmeters—as well as oscilloscopes—with the easy-to-build pocket-size calibrator described, beginning on page 49.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

July 1982 Vol. 53 No. 7

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Add a voice to your projects with just 5 IC's. **L. Steven Cheairs**

77 **SATELLITE TV RECEIVER**
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12 **SATELLITE/TELETEXT NEWS**
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72 **HOW TO DESIGN ANALOG CIRCUITS**
Designing circuits using special-purpose diodes. **Mannie Horowitz**

80 **PULSE GENERATORS**
The correct test setup for using pulse generators. **Charles Gilmore**

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An adaptor for your meter.

84 **HOBBY CORNER**
More on electronics for youngsters. **Earl "Doc" Savage, K4SDS**

92 **STATE-OF-SOLID-STATE**
A dual low-noise, high-performance op-amp. **Robert F. Scott**

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96 **SERVICE CLINIC**
Expect the unexpected. **Jack Darr**

96 **SERVICE QUESTIONS**
Radio-Electronics' Service Editor solves technician's problems.

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A new design for a high-selectivity audio filter. **Herb Friedman**

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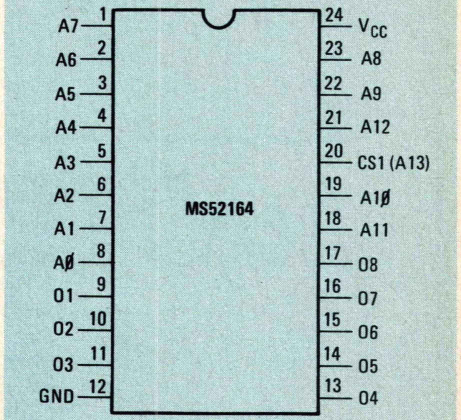
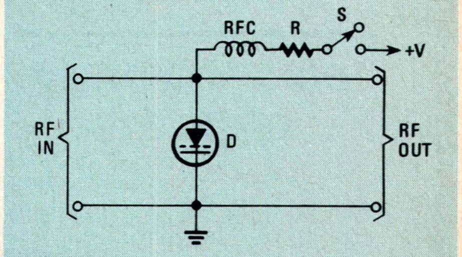
ON THE COVER

A behind-the-scenes look at the **Radio-Electronics** Videogame Testing Laboratory. Many long hours were spent gathering data for this month's special section on video and handheld electronic games. For an overall look at what's available in video and handheld games, turn to page 49.



SPEECH SYNTHESIZER uses this ROM and 4 more IC's. For the complete construction details, turn to page 43.



PIN DIODES are just one of the many specialized diodes covered in this month's installment of the analog-design series. The story starts on page 72.

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Radio-Electronics
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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS
August 1982 Vol. 53 No. 8

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43 PICTURE PHONE
Add the dimension of *sight* to your telephone conversations with this device. **Josef Bernard**

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65 ENERGY MISER
Bring down the high cost of heating. **Roland Gibson**

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Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

16 SATELLITE/TELETEXT NEWS
The latest happenings in communications technology. **Gary H. Arlen**

53 HOW TO DESIGN ANALOG CIRCUITS
An introduction to bipolar and FET transistors, and how they are used. **Mannie Horowitz.**

57 SOFT TOOLS
These chemicals are useful in any workshop. **Kirk Vistain**

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A model-rocket launcher.

68 HOBBY CORNER
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49 HOW TO SELECT THE BEST TV ANTENNA
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75 SERVICE CLINIC
Antenna rotators. **Jack Darr**

76 SERVICE QUESTIONS
R-E's Service Editor solves technician's problems. **Jack Darr**

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61 FROM STYLUS TO PHONO INPUT
All about modern phono cartridges. **Len Feldman**

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72 COMMUNICATIONS CORNER
Maximizing antenna gain. **Herb Friedman**

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28 Fox Marketing BMP10/60 Scanning Receiver

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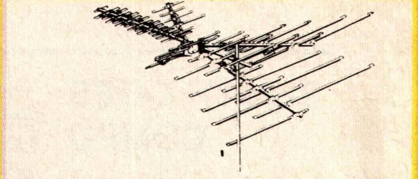
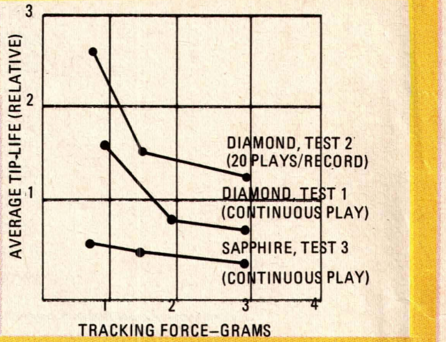
ON THE COVER

Up to now, about the only way you could add video to your telephone conversation was to go to one of a very few specially equipped Bell System centers. Even then, you could only talk with someone in another similarly equipped center—not a particularly convenient setup. Build a Picture Phone, and you can exchange pictures with anyone, anytime, anywhere, as long as both of you have one, and a telephone. The story starts on page 43.



GOOD VHF and UHF TELEVISION RECEPTION depends on many factors. Choosing the best system or configuration for your particular situation can be difficult, but for information that will make the task easier, turn to page 49.



THE SOUND QUALITY of even the best stereo systems can only be as good as the signal that is input from the phone cartrige. Find out more about phono cartridges, and whether you are getting the most out of yours. The story begins on page 61.

For those of our readers who have been awaiting the second part of our article on the stereo image expander, we promise that it will run in next month's issue.

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Electronics publishers since 1908

September 1982 Vol. 53 No. 9

SPECIAL FEATURE

53 **BUYING MAIL-ORDER COMPONENTS**
Mail-order is sometimes the only way to obtain the components you need. Here are some tips you should know and pitfalls you should avoid. **Karl T. Thurber, Jr., W8FX**

BUILD THIS

45 **HEART-RATE MONITOR**
Know the state of your health and fitness. This project displays your heart rate in beats-per-minute by simply attaching an opto-electronic sensor to your finger. **Robert Grossblatt**

49 **PICTURE PHONE**
Part 2—Adapter sends video pictures over the telephone line to a remote location. **Josef Bernard**

63 **STEREO IMAGE EXPANDER**
Part 2—Hi-fi adapter adds an extra dimension to your recorded music. **Joel Cohen**

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Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

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The latest happenings in communications technology. **Gary H. Arlen**

71 **ALL ABOUT PULSE GENERATORS**
How to use a pulse generator to test an analog circuit. **Charles Gilmore**

84 **STATE-OF-SOLID-STATE**
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42 **NEW IDEA**
Electronic thermometer.

59 **HOW TO DESIGN ANALOG CIRCUITS**
Proper transistor operation requires proper biasing. Learn about biasing circuits and how to design them. **Mannie Horowitz**

74 **HOBBY CORNER**
Learning about microprocessors. **Earl "Doc" Savage, K4SDS**

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92 **SERVICE CLINIC**
Color-burst reference oscillators. **Jack Darr**

92 **SERVICE QUESTIONS**
Radio-Electronics' Service Editor solves technicians' problems.

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66 **REPAIRING PORTABLE CASSETTE RECORDERS**
How to troubleshoot and repair these popular recorders. **Homer L. Davidson**

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78 **COMMUNICATIONS CORNER**
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80 **COMPUTER CORNER**
Electronic worksheets. **Les Spindle**

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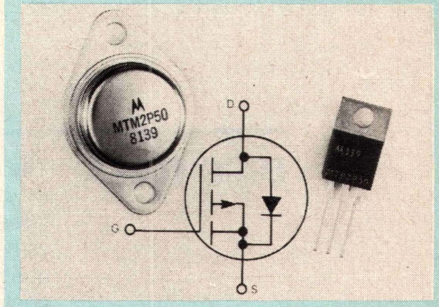
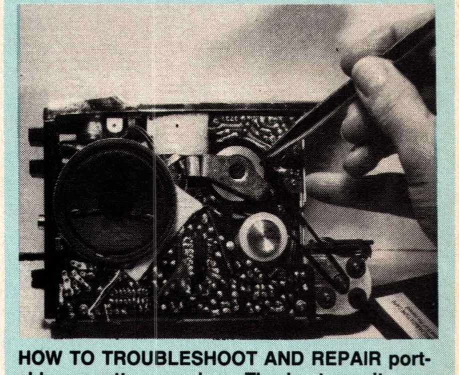
ON THE COVER

Using an otpo-electronic sensor that attaches to your finger, this battery-powered monitor displays your heart rate in beats-per-minute on a digital display. Knowing how your heart rate varies under different circumstances can give you an idea of your physical condition. Get started building yours today. The story starts on page 45.



HOW TO PROPERLY BIAS a transistor circuit is the subject of this month's analog design series. Must reading if your designs are to function the first time you plug them in. The story starts on page 59.



HOW TO TROUBLESHOOT AND REPAIR portable cassette recorders. The best results are obtained with a logical troubleshooting approach. The story starts on page 66.

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Radio-Electronics

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October 1982 Vol. 53 No. 10

SPECIAL FEATURE

43 YOUR OWN COMPUTER: HARDWARE, Marc Stern

45	$100-$500	85	$2500-3000
53	$500-$1000	91	$3000-$3500
60	$1000-$1500	97	$3500-$4000
73	$1500-$2000	104	$4000-$4500
78	$2000-$2500	106	$4500-$6000

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Part 3. Winding up the theory and beginning construction.
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Tomorrow's news and technology in this quickly changing industry.
David Lachenbruch

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The latest happenings in communications technology.
Gary H. Arlen

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A low-distortion, high-output op-amp. Robert F. Scott

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39 BUBBLE MEMORIES
How those high-density storage devices work. Robert F. Scott

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Audio oscillator contest results. Earl "Doc" Savage, K4SDS

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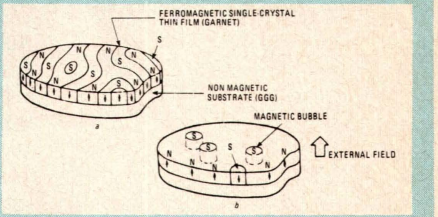
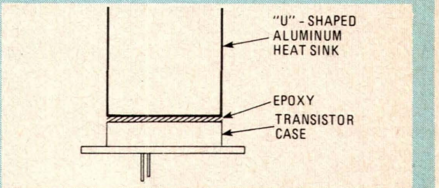
ON THE COVER

Microcomputers—for the home and for business—come in all sizes and prices. You can pay as little as $100 (or less!) or as much as $6000 (or more). To help you make an intelligent choice in selecting a computer that meets both your needs and your budget, our Special Section, "Your Own Computer," groups computers and computer systems by price. Also included are descriptions of software and services that you may find useful. And, to round things out, there's a discussion of 8-bit vs. 16-bit computers. "Your Own Computer" starts on page 43.



FERROMAGNETIC SINGLE-CRYSTAL THIN FILM (GARNET)
S
N
NON MAGNETIC SUBSTRATE (GGG)
a
MAGNETIC BUBBLE
EXTERNAL FIELD
b

BUBBLE MEMORIES COMBINE the read/write features of RAM with the non-volatility of ROM, and approach tape and disk systems in storage capacity. Find out how they work and how they're used starting on page 39.



DERATING CIRCUIT-COMPONENTS can extend their life and make the equipment in which they're used more reliable. This month's Service Clinic covers that topic, beginning on page 150.

Due to lack of space we are unable to include Part 2 of the "Heart-a-Matic" in this issue. It will appear next month.

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November 1982 Vol. 53 No. 11

SPECIAL FEATURES

39 BUYER'S GUIDE—CORDLESS TELEPHONES
Here's a look at what's available in terms of features, price, and performance of those popular devices. **Gordon McComb**

51 BUYING MAIL-ORDER COMPONENTS
Part 2—Mail-order is sometimes the only way to obtain the components you need. Here are some tips you should know, and some pitfalls you should avoid. **Karl T. Thurber, Jr., W8FX**

BUILD THIS

43 FREQUENCY MULTIPLIER FOR YOUR COUNTER
Add-on for your counter multiplies the signal frequency by either 10 or 100. This easy-to-build device increases the low-frequency range and accuracy of your counter. **Gary McClellan**

47 PICTURE PHONE
Final construction details as well as calibration, set-up, and use for this adapter that sends video signals over your telephone line. **Josef Bernard**

59 HEART-RATE MONITOR
Final construction details for a device that measures your heart rate and displays it on a digital display in beats-per-minute. **Robert Grossblatt**

79 GUITAR AND BASS TUNER
Easy-to-build musical "pitch pipe" that enables you to tune your guitar and bass instruments quickly. **James I. Jarnagin**

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The latest happenings in communications technology. **Gary Arlen**

75 ALL ABOUT BUBBLE MEMORIES
How those high-density memory devices work. **Robert F. Scott**

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67 HOW TO DESIGN ANALOG CIRCUITS
An in-depth look at single-stage transistor amplifiers. **Mannie Horowitz**

90 HOBBY CORNER
A new puzzle for our readers, plus a timer circuit using Schmitt gates. **Earl "Doc" Savage, K4SDS**

92 NEW IDEAS
Sample-and-hold probe for a DMM.

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More about capacitors. **Jack Darr**

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Using a computer to receive RTTY transmissions. **Herb Friedman**

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A look at the Osborne 1 portable computer. **Les Spindle**

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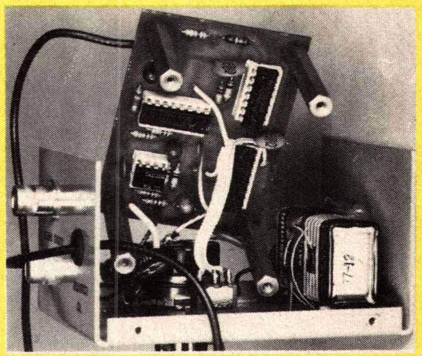
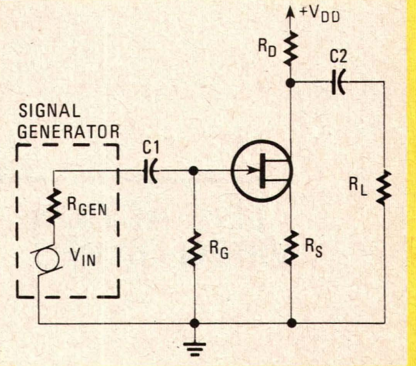
ON THE COVER

Cordless telephones are more than just a convenience; they can also save you money. Rather than have multiple-extension phones, you can use just one cordless phone and answer the telephone from anywhere inside the house—or from up to 1000 feet away. For an in-depth look at what's available, including prices and features, turn to page 39.



BUILD THIS FREQUENCY MULTIPLIER and increase the low-frequency range and accuracy of your frequency counter. Complete construction details start on page 43.



HOW TRANSISTOR AMPLIFIERS WORK, and how to design them, are covered in this month's installment of our back-to-school series. For the full details, turn to page 67.

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Danny Goodman

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Danny Goodman

63 **Video Accessories. Gordon McComb**

67 **How to Connect Video Components.**
Gary McClellan

BUILD THIS

43 **AUTOMATIC COMMERCIAL EDITOR**
Make commercial-free tapes of your favorite old black-and-white movies. **Gary McClellan**

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Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

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The latest happenings in communications technology.
Gary Arlen

90 **STATE OF SOLID STATE**
An all-electronic humidity meter. **Robert F. Scott**

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47 **ETCH YOUR OWN PC BOARDS**
Making your own PC boards is easier than you think. Here are step-by-step instructions from a master. **Robert Grossblatt**

75 **HOW TO DESIGN ANALOG CIRCUITS**
Increasing circuit gain. **Mannie Horowitz**

84 **NEW IDEAS**
Low-battery indicator.

100 **HOBBY CORNER**
Readers to the rescue. **Earl "Doc" Savage, K4SDS**

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R-E's Service Editor solves technicians' problems. **Jack Darr**

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SEASON'S GREETINGS

The editors and staff
of Radio-Electronics
join in sending
holiday greetings and
our best wishes for
a happy new year

ON THE COVER

If you like to tape those vintage black-and-white movies that show up late at night on TV—but don't like to tape the commercials that accompany them—this automatic commercial editor is for you! It watches the movie along with your VCR and, when a commercial turns up, stops the tape until the movie begins again. The result is a tape of the movie, and nothing else. It's easy to build, and will...literally...provide you with hours of pleasure. Get started building your own editor. Plans begin on page 43.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

JANUARY 1983 Vol. 54 No. 1

BUILD THIS

39 **PROGRAMMA III DIGITAL IC TESTER**
A versatile device that puts IC's through their paces and indicates how they function. **Gary McClellan**

47 **LOW-BAND CONVERTER**
There are lots of interesting things going on on the frequencies below the AM broadcast-band. Build this converter and find out for yourself what they are. **Stan Gibilisco**

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Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

12 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

44 **ALL ABOUT PAGERS**
How those ubiquitous "beepers" work. **Pete DeHaan**

55 **FASTER THAN LIGHT**
Is it possible that electrical impulses *can* travel faster than the speed of light? **Harold W. Milnes, Ph.D**

90 **STATE OF SOLID STATE**
A new digital-lock circuit. **Robert F. Scott**

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Preparing the photo artwork. **Robert Grossblatt**

63 **HOW TO DESIGN ANALOG CIRCUITS**
An introduction to the most popular analog IC, the operational amplifier. **Mannie Horowitz**

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Which way does the current flow? **Jack Darr**

72 **SERVICE QUESTIONS**
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78 **COMMUNICATIONS CORNER**
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The plug-programmable Programma III allows you to perform static and dynamic testing of all TTL and CMOS digital IC's, and presents you with a graphic visual indication of the logic state at each pin of the IC under test. Instructions for building this valuable addition to your test equipment begin on page 39.

ANNUAL INDEX JANUARY—DECEMBER

1982

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size) to:*

Radio-Electronics
Annual Index
45 East 17th Street
New York, NY 10003

Any requests postmarked on or before April 30 are free. After that date there is a 50¢ fee. Questions and comments about anything other than the Index that are included with your request cannot be handled. Send them separately to our Editorial Offices.

Because of space restrictions, the second part of the "Automatic Commercial Editor" will not appear in this issue. It *will* appear next month.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

FEBRUARY 1983 Vol. 54 No. 2

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39 INSIDE THE 757/767 COCKPIT
The cockpit of Boeing's new 757/767 airplane is crammed with computer and automated flight systems. Here's a look at those systems and what may be the future trend in commercial aircraft. **Marc Stern**

BUILD THIS

43 ATARI VIDEOGAME CONTROLLER
Unique controller replaces your Atari joysticks and uses position-sensitive mercury switch for a new dimension in game playing. **David J. Sweeney**

57 AUTOMATIC COMMERCIAL EDITOR
Part 2—Add-on device for your VCR automatically eliminates commercials from your favorite black-and-white movies. **Gary McClellan**

59 DIGITAL IC TESTER
Part 2—A versatile tester that puts digital IC's through their paces and indicates how they function. **Gary McClellan**

TECHNOLOGY

8 VIDEOGAMES
A new column dedicated to the expanding videogame industry, including reviews of specific videogame cartridges.

92 STATE-OF-SOLID-STATE
All about switching power supplies and a new IC for controlling them. **Robert F. Scott**

CIRCUITS AND COMPONENTS

46 ETCH YOUR OWN PC BOARD
Part 3—Make even the most complicated PC board following these step-by-step instructions. **Robert Grossblatt**

50 HOW TO INTERFACE R/C SERVOS
Doing something mechanical with an electronic circuit usually requires a servo. Here's how to use commonly available radio-control servos to do the job. **Dan and Jeanette Pelton**

67 HOW TO DESIGN ANALOG CIRCUITS
Transistor power-amplifier circuits. **Mannie Horowitz**

82 THE DRAWING BOARD
If you like designing and building your own circuits, you are sure to like this new column. **Robert Grossblatt**

VIDEO

86 SERVICE CLINIC
The quickest way to find those faulty capacitors. **Jack Darr**

86 SERVICE QUESTIONS
R-E's Service Editor solves technicians' problems. **Jack Darr**

RADIO

63 ALL ABOUT VLF ACTIVE ANTENNAS
Good reception at very low frequencies does not necessarily require a very long antenna. **R.W. Burhans**

98 COMMUNICATIONS CORNER
Trap antennas for amateur-radio use. **Herb Friedman**

COMPUTERS

96 COMPUTER CORNER
Computers you can fit into a pocket. **Les Spindle**

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30 Heath Model H-25 Printer

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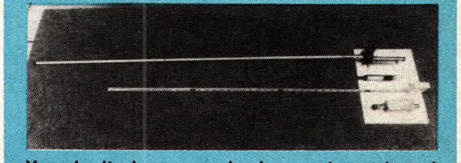
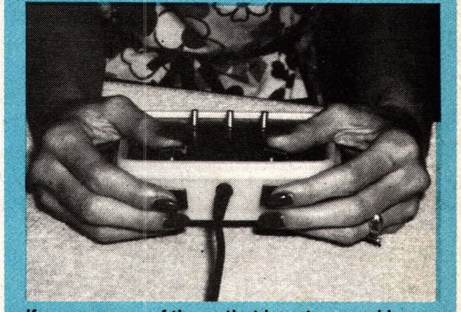
ON THE COVER

Once considered a dream, the computer-controlled airplane has become a reality, with the introduction of the Boeing 757/767 aircraft into commercial service. This month, we'll take you into the cockpit of that fascinating airplane, and show you the systems and features that help make it one of the most sophisticated in the sky.



You don't always need a long antenna to get good VLF reception. The active antennas shown here are just one meter long but often outperform ones many times their length. Find out more about active antennas, beginning on page 63.



If you are one of those that love to spend hours at a time with your home videogames, your hands are probably taking a beating. Give them and yourself a break, and build this controller for your Atari VCS system. The story starts on page 42.

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

MARCH 1983 Vol. 54 No. 3

SPECIAL FEATURE

49 **POCKET-SIZED AND PORTABLE SHORTWAVE RECEIVERS**
A look at the newest "small" shortwave receivers. Their features often rival those of older top-of-the-line table models. **Danny Goodman**

BUILD THIS

53 **DIGITAL IC TESTER**
Part 3. A versatile device that puts IC's through their paces and indicates how they function. **Gary McClellan**

59 **TWO COMPACT DVM'S**
Two inexpensive DVM circuits for your workbench. **Clement S. Pepper**

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4 **VIDEO ELECTRONICS**
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

12 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

14 **VIDEOGAMES**
A new stand-alone system and two game-cartridge reviews. **Danny Goodman**

43 **INSIDE A 757/767 COCKPIT**
Part 2. A look at the Boeing 757/767's computer and automated-flight systems. **Marc Stern**

90 **STATE OF SOLID STATE**
A new IC for use in a professional-quality compressor, expander, or compandor. **Robert F. Scott**

CIRCUITS AND COMPONENTS

65 **ALL ABOUT VLF ACTIVE ANTENNAS**
Part 2. Some practical VLF active antennas for wideband and narrowband operation. **R.W. Burhans**

73 **HOW TO DESIGN ANALOG CIRCUITS**
Audio power-amplifier circuits. **Mannie Horowitz**

78 **NEW IDEAS**
Control your household appliances using a clock radio.

80 **HOBBY CORNER**
Our readers solve the light-switch puzzle. **Earl "Doc" Savage, K4SDS**

82 **THE DRAWING BOARD**
Adding a digit select to the BCD encoder. **Robert Grossblatt**

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86 **SERVICE CLINIC**
Thermal problems and how to correct them. **Jack Darr**

88 **SERVICE QUESTIONS**
R-E's service editor solves technicians' problems.

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56 **HOW TO REPAIR ANTIQUE RADIOS**
The ins and outs of restoring an old radio's appearance and performance. **Richard D. Fitch**

98 **COMMUNICATIONS CORNER**
Communications and the computer. **Herb Friedman**

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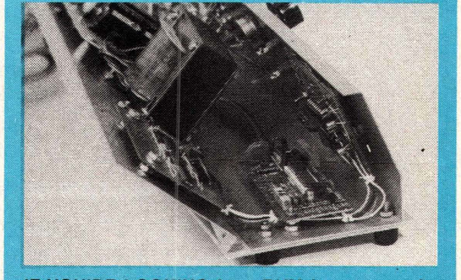
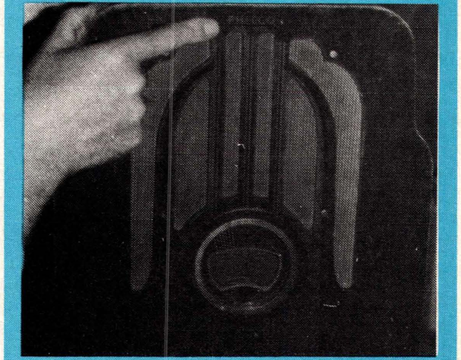
ON THE COVER

Portable shortwave-receivers with features like microprocessor-controlled PLL tuning and digital readouts, and pocket-sized shortwave receivers with "big"-radio performance, were once just dreams. Both types are now realities, as you'll see in our story on pocket-sized and portable shortwave receivers. The article begins on page 49.



IF YOU'RE LOOKING for a DVM for your workbench, one of those described here may be for you. Thanks to the use of LSI IC's, the circuits are small and inexpensive to build. The story begins on page 59.



EVEN THOUGH MODERN RADIOS are sleek, and are great performers, there's something about the old ones that makes most of us feel nostalgic. Find out how you can restore an old radio's original sound and appearance starting on page 56.

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS
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117 BUDGET SOFTWARE Herb Friedman
127 "WHAT IF" SOFTWARE Herb Friedman

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43 ADD A VIDEO INPUT TO YOUR TV
Modify your television set to accept a baseband video signal for better picture quality when using a computer or VCR. John Soluk

49 BUILD YOUR OWN CUSTOM CASES
Give your projects a professional look with custom-built cases. Robert Grossblatt

132 VLF-HF ACTIVE ANTENNAS
Part 3. These short-length antennas are easy to build and offer surprisingly good performance. R.W. Burhans

136 SPOT-A-MATIC
An illuminating project. Robert Grossblatt

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Tomorrow's news and technology in this quickly changing industry. David Lachenbruch

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The latest happenings in communications technology. Gary H. Arlen

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Supercharge your Atari *2600*. Danny Goodman

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An expander for your Hi-Fi. Robert F. Scott

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Turning a clock into a timer. Earl "Doc" Savage, K4SDS

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155 SERVICE CLINIC
There's nothing really new about fixing those new TV sets. Jack Darr

156 SERVICE QUESTIONS
R-E's Service Editor solves technicians' problems.

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ON THE COVER

The fascinating world of microcomputers—whether it be a simple entry-level machine for education or entertainment, or a complex, full-featured computer for your business—there's something there for everyone. And there's something for everyone in our Special Section, "Your Own Computer." This month we take an in-depth look at the hardware and the things you should know before you buy. To round things out, "Your Own Software" takes a look at one of the most popular types of software—the electronic spreadsheet—and a look at some software you may never have heard of, but that's surprisingly useful and/or inexpensive. It all starts on page 57.

A CUSTOM CASE will give your project a professional look and get it the attention it deserves. It can be surprisingly easy and inexpensive to build if you know how. Find out more starting on page 49.

COMING NEXT MONTH
On Sale April 19

- **Build A Talking Clock.** This clock not only tells the time, it says it.
- **Car Alarm.** Connect it to your car to help keep the burglars away.
- **All About LSI Music Synthesizers.** A look at the different IC's available to build your own music synthesizers.
- **And more.**

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

MAY 1983 Vol. 54 No. 5

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57 **TALKING ALARM CLOCK**
Only a few IC's are needed to build a clock that *really* tells time. **Lee Glinsky**

61 **CAR BURGLAR ALARM**
An inexpensive form of insurance that can avert an automobile break-in. **Edward W. Loxterkamp**

73 **VLF-HF PASSIVE ANTENNA TUNER**
Another approach to optimizing reception at very-low frequencies. **R.W. Burhans**

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4 **VIDEO ELECTRONICS**
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

12 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

14 **VIDEOGAMES**
Games that talk. **Danny Goodman**

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54 **NEW IDEAS**
Easy liquid rosin flux.

65 **MUSIC SYNTHESIZER IC's**
Large-scale-integration IC's have greatly simplified the design of electronic music-synthesizers. **Thomas Henry**

69 **D/A CONVERTER APPLICATIONS**
The ins and outs of DAC's. **Joseph J. Carr**

77 **REWINDING TRANSFORMERS**
Can't locate a transformer that meets your needs? Make your own. **Don. A. Meador**

81 **HOW TO DESIGN ANALOG CIRCUITS**
Using audio-output transistors. **Mannie Horowitz**

86 **HOBBY CORNER**
How to change cassette-recorder speeds. **Earl "Doc" Savage, K4SDS**

90 **THE DRAWING BOARD**
Regulated power supplies. **Robert Grossblatt**

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94 **SERVICE CLINIC**
An unusual output-stage problem. **Jack Darr**

96 **SERVICE QUESTIONS**
R-E's Service Editor solves technicians' problems.

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50 **COMPUTER CORNER**
What to look for in a terminal. **Les Spindle**

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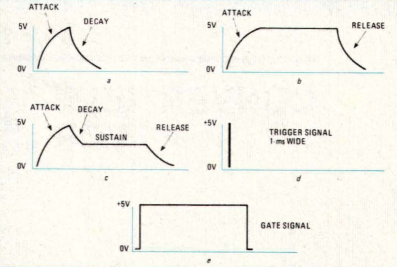
ON THE COVER

Timepieces have come a tremendous way in the past few years—from wind-up and electric clocks to those with LED and LCD displays and—now—to clocks with no display at all! The talking alarm clock featured in this issue will announce the time either automatically or on request. and can also be set to *tell* you when it's time to get up. Modern speech-synthesis IC's make it extremely easy to build, as you'll find out starting on page 57.



THE MAINSTAY of today's popular music is the synthesizer. Once incredibly difficult and expensive to design and build, its current popularity is due in part to the versatility built into the LSI IC's that are found at its heart. The story of those IC's can be found on page 65.

COMING NEXT MONTH
On Sale May 19

- **Special Videogames Section:** What's new for 1983...and what's in store for the future.
- **Add-on RAM.** A non-volatile 8K memory expansion you can build for your Timex/Sinclair *1000.*
- **LF Loop Antennas.** The next installment on our continuing series on VLF-LF receiving techniques.
- **And lots more!**

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JUNE 1983 Vol. 54 No. 6

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A buyer's guide to electronic games. **Danny Goodman**
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59 NEW FOR COLECOVISION
62 ATARI 5200
65 STARPATH'S SUPERCHARGER FOR ATARI
68 VECTREX
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73 THE TOP TEN GAMES OF '83
77 VIDEOGAMES THAT TALK
80 HANDHELD AND TABLETOP GAMES

BUILD THIS

51 AUDIO FREQUENCY-RESPONSE METER
Quickly and accurately find the frequency response of your amplifiers, tape recorders, and other audio equipment with this useful device. **Ray Fish**

TECHNOLOGY

4 VIDEO ELECTRONICS
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**
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The latest happenings in communications technology. **Gary H. Arlen**
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Computers vs. videogames. **Danny Goodman**
83 LOW-FREQUENCY LOOP ANTENNAS
Part 5—A look at some highly directional antennas that do an outstanding job at low and very-low frequencies. **R.W. Burhans**

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88 HOBBY CORNER
How to make your solar collector "follow" the sun. **Earl "Doc" Savage, K4SDS**
92 DRAWING BOARD
Turn fixed voltage regulators into adjustable ones. **Robert Grossblatt**
96 NEW IDEA
Frequency-boundary indicator.
109 STATE OF SOLID STATE
A solid-state brightness controller. **Robert F. Scott**

VIDEO

98 SERVICE CLINIC
All about countdown circuits—what they are, what you see when they fail, and how to fix them. **Jack Darr**
98 SERVICE QUESTIONS
R-E's Service Editor solves technicians' problems.

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106 COMMUNICATIONS CORNER
Satellite technology and the mail. **Herb Friedman**

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26 Realistic Wide Range Stereo Frequency Equalizer
30 Micro-Professor II Microcomputer

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ON THE COVER

Electronic games, both video and handheld, have been extremely popular for several years now. But this past year has seen the introduction of more videogame consoles, hardware add-ons, and game software than in all previous years combined. This month, we present a special section dedicated to helping you find your way through the ever-more-confusing world of electronic games. We'll tell you what's new, what's hot, and how to get the most out of your videogame system. The section begins on page 55.

FRONT PANEL of the audio frequency-response meter. This instrument will, among other things, allow you to set your tape recorder's bias and equalization controls with extreme precision. The story starts on page 51.

COMING NEXT MONTH
On Sale June 16

- **Automotive navigation systems.** With these computer-based systems you'll never get lost again.
- **Loran-C.** A look at this fascinating low-frequency, long-range navigational system.
- **Add-on RAM.** The article on how to add 8K of non-volatile RAM to your Timex/Sinclair *1000*, bumped from this issue because of lack of space will appear in July.
- **And lots more!**

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Radio-Electronics

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JULY 1983 Vol. 54 No. 7

SPECIAL FEATURE

43 **ALL ABOUT AUTOMOTIVE NAVIGATION SYSTEMS**
Computer-aided navigation is expected to play a big part in the car of the future. But, as this report shows, that future is not all that far away. **Danny Goodman**

BUILD THIS

47 **EXPAND YOUR TIMEX/SINCLAIR OPERATING SYSTEM**
Upgrade your computer with 8K of battery-backed-up CMOS RAM. **Paul W.W. Hunter**

51 **TALKING ALARM CLOCK**
Part 2. With this fun project *you'll* never have to tell time again. **Lee Glinski**

59 **DIGITAL VOLTMETER FOR YOUR CAR'S DASHBOARD**
This easy-to-build project helps keep an eye on your car's electrical system. **Fred L. Young Sr. and Fred L. Young Jr.**

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4 **VIDEO ELECTRONICS**
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

10 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

12 **VIDEOGAMES**
A new generation of videogames. **Danny Goodman**

63 **USING LORAN-C FOR TIME AND FREQUENCY CALIBRATION**
All about the Loran-C navigational system and how it works. **R.W. Burhans**

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55 **TRANSCONDUCTANCE OPERATIONAL AMPLIFIERS**
What they are, and some practical examples of how to use them. **Thomas Henry**

68 **HOW TO DESIGN ANALOG CIRCUITS**
An in-depth look at positive- and negative-feedback circuits. **Manny Horowitz**

74 **NEW IDEAS**
An award-winning project from one of our readers

76 **HOBBY CORNER**
Some questions from the mailbag. **Earl "Doc" Savage, K4SDS**

78 **DRAWING BOARD**
More on voltage regulators. **Robert Grossblatt**

80 **STATE OF SOLID STATE**
Power MOSFET amplifiers. **Robert F. Scott**

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A dish full of bugs. **Jack Darr**

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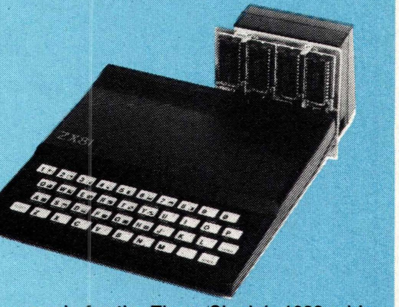
To most drivers, one of the most exasperating experiences is getting lost in completely unfamiliar territory. But an independent California inventor and a giant Japanese automobile manufacturer are hard at work trying to make that situation a thing of the past. If their efforts are successful, it won't be long until a common automotive accessory will be a navigational computer complete with a video display. This month, we'll preview the future and take a look at both systems. The story begins on page 43.



This upgrade for the Timex/Sinclair 1000 adds 8K of non-volatile RAM. The add-on can be used to increase the system/user memory, or more usefully, for the permanent storage of machine-language routines—thus, in effect, expanding the operating system. Find out more about it starting on page 47.

COMING NEXT MONTH

On Sale July 19

A special section devoted to electronics and photography. Among the things we'll look at are:
- **The Sony Mavica system**
- **Autofocus and autoexposure electronics**
- **Electronics in the darkroom**

And lots more!

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

AUGUST 1983 Vol. 54 No. 8

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A game-development system for the Atari. **Danny Goodman**

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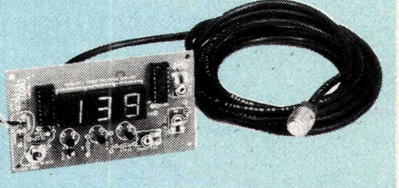
ON THE COVER

One field that has been strongly affected by microelectronics is that of photography. Once-bulky equipment is now built right into pocket-size cameras. And, in the darkroom, microprocessors are making things as easy as 1-2-3. Sony has even unveiled a completely filmless electronic-photography system. All that, and more, is covered in our special section on electronics and photography beginning on page 57.



AS YOUR CAR creeps along in the stop-and-start summertime traffic, its most dangerous enemy is probably the heat. And you have no idea how badly your engine is suffering until the "idiot light" marked "TEMP" comes on...and the radiator blows its top! This digital temperature gauge will let you know at any time exactly how hot the engine is, and allow you to cool things off before it's too late. Construction details start on page 92.

COMING NEXT MONTH
On Sale August 18

- **The Pianomatic.** An attention-getting programmable music maker you can build yourself.
- **ECL.** A tutorial on emitter-coupled logic.
- Plus lots more!

Because of lack of space, the installment of "Analog Design" scheduled to appear this month will appear in next month's issue.

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Radio-Electronics®

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SEPTEMBER 1983 Vol. 54 No. 9

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A look at some of the outstanding products of the past year as honored at this past summer's CES. **Danny Goodman**

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A music box that can "remember" up to four tunes. **Robert Grossblatt**

57 **POWERLINE TRANSIENT SUPPRESSOR**
Keep your computer and its contents safe with this simple yet effective device. **Herb Friedman**

59 **DIGITAL PRESSURE GAUGE FOR YOUR CAR**
A handy instrument that can warn you of problems before they become critical. **Fred L. Young Sr. and Fred L. Young Jr.**

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62 **FREQUENCY CALIBRATION USING WWV**
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ON THE COVER

Projects that are built just for fun are sometimes enjoyed most of all. But what's even better is a fun project that can teach you something new. The Pianomatic mini player-piano does just that. Sure to be an entertaining conversation piece when it is finished, building it will introduce you to such topics as computer memory organization and retention, digital logic, keyboard encoding and decoding, and the like. As a bonus, the techniques you'll pick up here can easily be adapted for use in your own designs. The story begins on page 43.

THE KOALAPAD from Koala Technology, Inc., allows you to control your computer's cursor movement by just tracing on the touch-sensitive pad. It's just one of the most innovative products of the past year as honored at the Summer CES. Turn to page 49 to find out more about it, and others similarly honored.

COMING NEXT MONTH
On Sale September 15

Our special supplement: Your Own Computer. Among the things we'll look at are:

- **Hardware**—a comprehensive look at systems, and their cost!
- **Word-processing software**
- **Software and hardware compatibility**
- **Everything you need to know about CP/M**
- **And lots more!**

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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OCTOBER 1983 Vol. 54 No. 10

SPECIAL FEATURE

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A round-up of the computer systems currently available, organized in price categories from under $500 to over $4500. **Marc Stern**

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ON THE COVER

There's little doubt that personal computers have become the fastest growing segment of the consumer-electronics market. In the past year many new companies have been founded, and scores of new machines have been introduced. In addition, most of the "established" manufacturers (in this industry that's anyone that's been around longer than two years) have either unveiled new systems, or beefed-up their existing ones, to remain competitive. The result has been greatly increased selection, generally lower prices, and just about utter confusion for the consumer. That's where this special section comes in—it's designed to help you make sense out of the jumble of systems by summarizing what's available. To help make comparisons easier, everything is organized by list price. The section begins on page 75.

TO OUR READERS

Due to our large computer-hardware section, several articles that were originally scheduled for this issue could not appear, due to space limitations. Those articles will be published in coming months.

COMING NEXT MONTH
On Sale October 20

- **Test Equipment.** A look at what's new and unusual.
- **Audio Tape.** Audio-cassette tapes and how they differ.
- **How To Design Analog Circuits.** All about filters.
- **And lots more!**

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DECEMBER 1983 Vol. 54 No. 12

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49 **VIDEO COLOR PROCESSOR**
Give your new videotapes that "professionally edited" look, and spruce up your old tapes for more enjoyable viewing.
Roger Cota and Lloyd Addington

58 **NEW IC'S FOR DIGITAL TV**
A look at the not-too-distant future in consumer-television design.
Robert Grossblatt

64 **VCR REPAIRS AND ADJUSTMENTS THAT YOU CAN DO**
Repairing VCR's should, in general, be left to professionals. But here are some things you can do for yourself. **John D. Lenk**

69 **WHAT'S NEW IN PORTABLE VIDEO**
A look at what's current and what's to come in the portable-video industry. **Carl Laron**

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75 **TYPEWRITER-TO-COMPUTER INTERFACE**
Now you can get letter-quality printing on a budget by using your IBM typewriter as a printer—with a 30K buffer! **Bill Green**

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If you're bothered by interference from local broadcast-band stations, here's something you can do something about it.
R. W. Burhans

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SEASON'S GREETINGS

The editors and staff
of Radio-Electronics
join in sending
holiday greetings and
our best wishes for
a happy new year

ON THE COVER

If you're like many home-video hobbyists, your videotapes leave something to be desired. Your colors may appear washed out, the picture is filled with noise, or, perhaps your edits are far from smooth. Well, there's a way around those problems, whether you're making new tapes or duplicating old ones. With the color processor you can create fade-ins and fade-outs, reduce background noise, and you can vary color saturation from black-and-white to full chrominance. The article describing its construction—which is only one of our special video features this month—begins on page 49.

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SPECIAL FEATURE

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Build a working model of a magnetohydrodynamic generator. **John Iovine**

69 **TYPEWRITER-TO-COMPUTER INTERFACE**
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8 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

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67 **HOW TO USE DIGITAL PANEL METERS**
A look at digital panel meters and how you can successfully use them in your projects. **Ray Marston**

84 **HOW TO DESIGN SEMICONDUCTOR SWITCHING CIRCUITS**
This installment in our back-to-school series looks at how PUT's, UJT's, SCR's, and other semiconductor devices can be used in switching applications. **Mannie Horowitz.**

94 **HOBBY CORNER**
Testing batteries. **Earl "Doc" Savage, K4SDS**

97 **NEW IDEAS** PLANT WATER MONITOR
An award-winning project from one of our readers.

98 **STATE OF SOLID STATE**
Metal-sensing devices. **Robert F. Scott**

100 **DRAWING BOARD**
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Part 3. Repairing or adjusting a VCR isn't easy, but there are some things you can do yourself. **John D. Lenk**

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A pulse-width-modulated power supply. **Jack Darr**

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All about one of the most popular computer operating-systems. **Abe Isaacs**

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A look at some popular hardware and software that makes it possible for your computer to communicate with others. **Herb Friedman**

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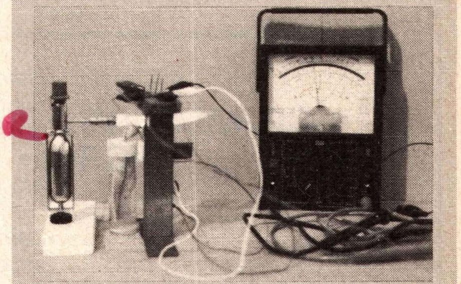
ON THE COVER

To say that cable-TV has undergone tremendous growth over the past few years would be an understatement. One of the biggest reasons for that growth is the presence on cable of first-run movies and live sporting events. Of course, that programming is most often offered as a premium service, which means that the viewer must pay a charge to receive it. To prevent unauthorized reception, the material is scrambled. This month, we'll use an experimental descrambling circuit to illustrate the theory behind the techniques used to encode video signals. The story begins on page 47.



ELECTRIC POWER GENERATION is among the most important areas of electronics. One method of power generation that has received quite a bit of attention is MHD. This month, we'll show you the theory behind that technique and build a working model of an MHD generator. The story starts on page 51.

COMING NEXT MONTH
On Sale February 21

- **Video Test Generator.** A valuable instrument for video servicing.
- **Airplane Landing Systems.** A look at landing systems and the electronics behind them.
- **And lots more!**

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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MARCH 1984 Vol. 55 No. 3

SPECIAL FEATURE

49 **INSTRUMENT LANDING SYSTEMS**
Though many people are afraid to fly, airplanes are the safest way to go—thanks to instrument landing systems. **Bill Sewell**

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43 **VIDEO TEST GENERATOR**
This test generator can be used not only for TV servicing. You can use it to service just about any video equipment. **Gene Roseth**

54 **AUDIO-FREQUENCY GENERATOR**
Use this AF generator with digital frequency readout to test your audio system. **Richard Schroeder**

59 **NO MORE WRONG NUMBERS**
Build this telephone add-on and never be bothered by wrong numbers or unwanted telephone sales calls again! **Gary McClellan**

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Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

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An award-winning project from one of our readers.

63 **HOW TO USE DIGITAL PANEL METERS**
Part 2. We'll show you how to use digital panel meters to measure frequency and temperature. **Ray Marston**

67 **HOW TO DESIGN POWER SUPPLIES**
This month, our back-to-school series shows you how to design regulated and unregulated DC power supplies. **Mannie Horowitz**

76 **HOBBY CORNER**
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ON THE COVER

There are many manufacturers who sell TV-test equipment such as dot-pattern generators. But if you want to service video equipment other than TV's, then you need something more. This month we'll describe how to build and how to use a full-feature video test generator. You can use it to test VCR's, monitors, video amplifiers—just about any video equipment. It not only generates standard test patterns. It even has provision for external inputs (from a computer, for example) so that you can create your own test patterns for your own specific purpose. The story begins on page 43.

ANNUAL INDEX JANUARY—DECEMBER 1983

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size) to:*

Radio-Electronics
Annual Index
45 East 17th Street
New York, NY 10003

Any requests postmarked on or before April 30 are free. After that date there is a 50¢ fee. Questions and comments about anything other than the Index that are included with your request cannot be handled. Send them separately to our Editorial Offices.

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Radio-Electronics

THE MAGAZINE FOR NEW
IDEAS IN ELECTRONICS

Electronics publishers since 1908

APRIL 1984 Vol. 55 No. 4

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59 **YOUR OWN COMPUTER**
What to look for in accessories and software for your personal computer, and what's new in portable and totable systems, are among the highlights of this special section.

61 **DON'T GET STUCK. Herb Friedman**

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10 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

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47 **HOME CONTROL COMPUTER**
This device lets you put your appliances under computer control, without tying up your personal computer. **Steven E. Sarns**

56 **VIDEO TEST GENERATOR**
Part 2. A low-cost, general-purpose video test generator that you can build. **Gene Roseth**

83 **NO MORE WRONG NUMBERS**
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A light-sensitive timer.

40 **DRAWING BOARD**
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Low-voltage amplifier circuits. **Robert Grossblatt**

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How to test transistors. **Earl "Doc" Savage, K4SDS**

98 **STATE OF SOLID STATE**
Making true RMS measurements. **Robert F. Scott**

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VCR control circuits. **Jack Darr**

107 **SERVICE QUESTIONS**
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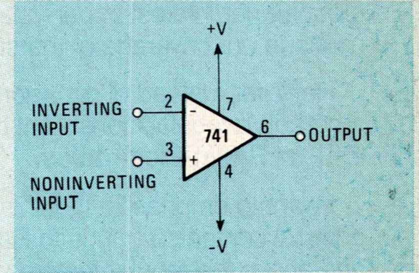
ON THE COVER

Owners of personal computers know that one of the natural uses for those devices is as a controller for the appliances, lights, or what have you in your home. But if you use it for that, your computer can not be used for any other task at the same time. This month we show you a way around that problem—a computer that you can build that's specifically for use as a controller. The story begins on page 47.



KNOWING ABOUT LINEAR IC's and how to use them in your designs can greatly improve your enjoyment of electronics. But if you missed out on learning about those devices, where can you get the information you need to use them successfully? One place is in our new back-to-school series on designing with linear IC's. It all begins on page 89.

COMING NEXT MONTH
On Sale April 19

- **Automotive Exhaust Analyzer.** A unique device to help get your car ready for those tough emissions tests.
- **3-D TV.** A look at what's coming in 3-D television.
- **Home Control Computer.** Part 2 of our build-it-yourself computer.
- **And lots more!**

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Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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MAY 1984 Vol. 55 No. 5

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47 **AUTOMOTIVE GAS ANALYZER**
Does your state require an annual emissions test? Now you can be sure that your car will pass. **Philip M. Van Praag**

61 **NO MORE WRONG NUMBERS**
Part 3. We start this month with details on construction. Then we'll show you how to hook everything up to keep those unwanted calls away. **Gary McClellan**

64 **HOME CONTROL COMPUTER**
Part 2. We'll take our first look at the computer's second board, which contains the power-supply and remote-control circuitry. Then we'll look at the I/O system. **Steven E. Sarns**

TECHNOLOGY

4 **VIDEO ELECTRONICS**
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

12 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

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A proximity power switch.

40 **DRAWING BOARD**
Bipolar power supplies—a look at reader responses. **Robert Grossblatt.**

42 **DESIGNER'S NOTEBOOK**
How to expand the range of the 4017 counter. **Robert Grossblatt**

75 **MAKING MEASUREMENTS ELECTRONICALLY**
We'll introduce you to a variety of transducers and show you how you can use them effectively. **Harry L. Trietley**

80 **DESIGNING WITH LINEAR IC'S**
Part 2. We'll look at the inverting follower and how to solve some problems commonly encountered with op-amps. **Joseph J. Carr**

92 **HOBBY CORNER**
Finding the location of a transmitter. **Earl "Doc" Savage, K4SDS**

96 **STATE OF SOLID STATE**
A spatial, stereo, and pseudo-stero sound IC. **Robert F. Scott**

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57 **WHAT'S NEW IN 3-D TV**
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100 **SERVICE CLINIC**
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103 **SERVICE QUESTIONS**
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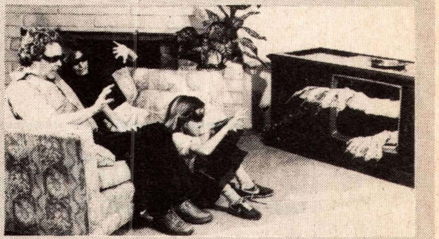
ON THE COVER

Does your state require that your car pass an annual emissions tests? In those states that do, many "do-it-yourselfers" are beginning to feel left out. After all, who else but the state-licensed inspection shop can make the emission test? If you build this month's featured project, you'll be able to keep tabs on your own emissions—even while you're driving! The story begins on page 47.



WILL THERE EVER BE A 3-D TV system that will give us more than eye strain? Carl Laron, our Associate Editor takes a look at three systems that look promising. Each has its own advantages—and drawbacks. But one thing is sure: You'll be hearing a lot more about those systems in the future. But read about them here first, starting on page 57.

COMING NEXT MONTH
On Sale May 22

- **Satellite TV.** A special section that deals with antennas, downconverters, receivers, and more, including a look at DBS.
- **Repairing PC Boards.** It's easy—we'll show you
- **Tuning Microwave Downconverters.** It's easier than you think and you don't have to perch yourself on your roof!
- **And lots more!**

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

JUNE 1984 Vol. 55 No. 6

SPECIAL FEATURE

45 **RECEIVING SATELLITE TELEVISION**
Learn about satellite TV and the components that make up a home TVRO system. **Martin Clifford**

47 **ALL ABOUT SATELLITE TV**

51 **THE DISH**

61 **SATELLITE RECEIVERS**

67 **FROM FEEDHORN TO RECEIVER**

75 **DIRECT-BROADCAST SATELLITES**

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41 **SOLID-STATE BAROMETER**
Make your own weather predictions with this fun project. **Sudhir H. Gupta.**

78 **HOME CONTROL COMPUTER**
Part 3. We wrap up our look at a control computer that's ideal for home-control applications. **Steven E. Sarns**

81 **AUTOMOTIVE EXHAUST ANALYZER**
Part 2. A useful test instrument that helps get your car ready for those tough emissions tests. **Philip M. Van Praag**

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14 **SATELLITE/TELETEXT NEWS**
The latest happenings in communications technology. **Gary H. Arlen**

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Turn-signal alarm.

86 **HOBBY CORNER**
Finding replacement parts. **Earl "Doc" Savage, K4SDS**

88 **DRAWING BOARD**
Smoothing out the sinewave-generator output. **Robert Grossblatt**

90 **DESIGNER'S NOTEBOOK**
Charging indicators. **Robert Grossblatt**

92 **STATE OF SOLID STATE**
Regulator IC's. **Robert F. Scott**

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94 **SERVICE CLINIC**
Fixing half of a computer. **Jack Darr**

95 **SERVICE QUESTIONS**
Radio-Electronic's Service Editor solves technicians' problems.

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29 **Beta Electronics Pro-Kit 1 PC-Board Fabrication Kit**

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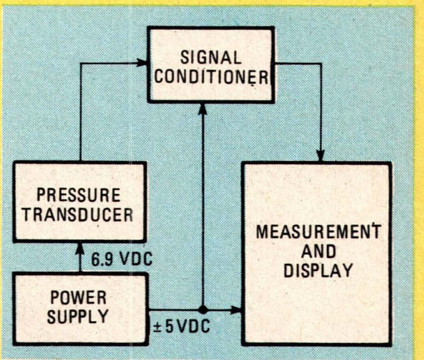
ON THE COVER

Satellite TV offers a lot of attractions, what with its promise of nearly unlimited viewer selection of TV programming. But is it for you? This month, **Radio-Electronics** turns its attention to satellite-TV, with a special section devoted, among other things, to home reception of satellite signals. It all begins on page 45.



BEFORE WEATHER SATELLITES, perhaps the most useful tool for weather prediction was the barometer. In this issue, we show you a solid-state barometer that you can build. The story starts on page 41.

COMING NEXT MONTH
On Sale June 21

- **Energy Mizer.** This useful project will help you get the most out of your air conditioning system.
- **Interfacing the *ZX81*.** Put your Timex/Sinclair computer to work with this practical interface.
- **A Unique Ammeter.** Here's a DC clamp-on ammeter you can build.
- **Repairing PC Boards.** Fixing those broken PC boards is easier than you think.
- **And lots more!**

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SEPTEMBER 84

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BUILD THIS

51 **SONIC MOTION DETECTOR**
No alarm system is complete without a motion sensor. **David M. Benzel**

63 **COMPUTER-CONTROLLED IC TESTER**
You can test digital IC's by hand, but your computer can do it better! **Floyd L. Oats**

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12 **VIDEO NEWS**
Tomorrow's news and technology in this quickly changing industry. **David Lachenbruch**

55 **ELECTRONIC MEASUREMENTS IN MEDICINE**
Here's a rundown on all of the "test instruments" that are used to monitor your heart. **Ray Fish, Ph.D, M.D.**

59 **WHAT'S NEW IN BATTERIES**
How do you choose the right battery for your project? Just how good are lithium batteries? Find out the answers to those, and other, questions. **Robert Grossblatt**

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46 **NEW IDEAS**
This pulsating doorbell will get your attention!

67 **SQUAREWAVE GENERATOR CIRCUITS**
We'll show you many practical variations of the squarewave generator—one of the building blocks of modern electronics. **Ray M. Marston**

77 **DESIGNING WITH LINEAR IC'S**
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80 **DESIGNER'S NOTEBOOK**
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Modify your intercom to fit your needs. **Earl "Doc" Savage, K4SDS**

84 **DRAWING BOARD**
A look at the 4089 binary rate multiplier. **Robert Grossblatt**

86 **STATE OF SOLID STATE**
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The most valuable test equipment. **Jack Darr**

90 **SERVICE QUESTIONS**
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71 **INTERFACING THE ZX81**
Part 3. Your once-lowly ZX81 (or Timex Sinclair 1000) computer can control a security system and any AC device, and can even act as a thermometer. **Neil Bungard**

Following page 82 **COMPUTER DIGEST**
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88 **COMPUTER CORNER**
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OCTOBER 84

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63 RECEIVING SATELLITE TELEVISION
If you've been thinking of putting together your own TVRO system, let our buyer's guide help you out! **Marc Stern**

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69 SATELLITE-TV RECEIVERS

73 THE DISH

77 FEEDHORNS, WAVEGUIDES, AND LNA'S

80 MANUFACTURER LIST

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51 SATELLITE STEREO DEMODULATOR
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55 RECHARGEABLE BATTERIES
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59 ELECTRONICS IN MEDICAL IMAGING
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Some simple oscillator circuits.
Robert Grossblatt

88 HOBBY CORNER
Why be afraid of computers?
Earl "Doc" Savage, K4SDS

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Using the 4089 binary rate multiplier IC.
Robert Grossblatt

100 STATE OF SOLID STATE
Low-power amplifier IC's. **Robert F. Scott**

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NOVEMBER 84

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Vol. 55 No. 11

SPECIAL FEATURE

57 **TURNKEY SYSTEMS**
If putting together a satellite-TV system component-by-component scares you, you'll be happy to hear about turnkey systems. **Marc Stern**

BUILD THIS

60 **TELE-TOLL TIMER**
Keep tabs on your phone bills! This device automatically times all of your phone calls. **Gary McClellan**

65 **COMPUTER-CONTROLLED IC TESTER**
Part 3. In the concluding part of this article, we expand the IC tester by adding an EPROM programmer. **Floyd L. Oats**

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45 **OSCILLOSCOPES IN COLOR**
New breakthroughs in color-display technology may make the shadow-mask color CRT obsolete! **Carl Laron**

84 **SATELLITE TV**
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73 **DESIGNING WITH LINEAR IC's**
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77 **CMOS CLOCK CIRCUITS**
A multitude of versatile and inexpensive CMOS squarewave-generator circuits. **Ray Marston**

86 **NEW IDEAS**
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88 **DESIGNER'S NOTEBOOK**
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90 **DRAWING BOARD**
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49 **WARC 84**
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94 **COMMUNICATIONS CORNER**
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70 **INTERFACING THE ZX81**
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Vol. 56 No. 2

SPECIAL FEATURE:

47 SELECTING THE BEST RESISTOR/CAPACITOR
Finding the right value for your components is the easy part—there's a lot more to consider when choosing parts for your projects. **Victor Meeldijk**

BUILD THIS

55 TAPE STREAMER FOR YOUR COMPUTER
Can a cassette tape really be an alternative to a disk drive? This high-speed cassette interface comes close. And it works with any computer equipped with an RS-232 port! **Mike Huddleston**

69 ATARI GAME RECORDER
Part 3. In the concluding part of this article, we give you all the construction details you'll need to record Atari videogames on audio-cassette tape.
David A. Chan and Guy Vachon

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14 SATELLITE TV
A look at how LNA's have changed during the brief history of satellite TV.
Bob Cooper, Jr.

51 STEREO AUDIO FOR TV
Stereo TV is here at last! Here's an in-depth look at the FCC decision on multichannel television sound and what it means.
Brian C. Fenton

CIRCUITS AND COMPONENTS

73 ALL ABOUT THERMISTORS
Part 2. This month we finish our look at the basics and start to use thermistors in real circuit applications. **Harry L. Trietly**

77 DESIGNING WITH DIGITAL IC's
If digital logic left you behind, it's time to catch up with our new "Back-to-School" series. **Joseph J. Carr**

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Building a DC power supply.
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A melodious telephone ringer.

92 DRAWING BOARD
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Computers and communications.
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88 ANTIQUE RADIOS
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99 SERVICE QUESTIONS
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All about printers.
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The computer on a wrist is here!

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MARCH 85

Radio-Electronics
Electronics publishers since 1908

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A look at the specifications and features that you should know about before you shop for a multimeter. **Herb Friedman**

58 **WHAT'S NEW IN OSCILLOSCOPES**
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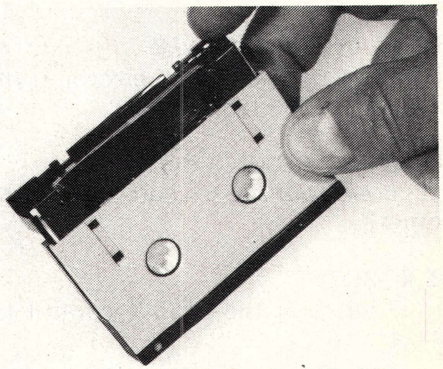

DIGITAL AUDIO TAPE: It's coming in the future. We'll cover the technical details of this promising new audio tape format in an up-coming issue.

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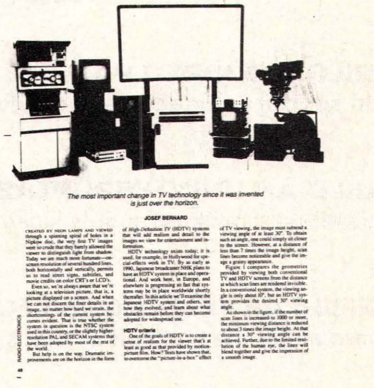

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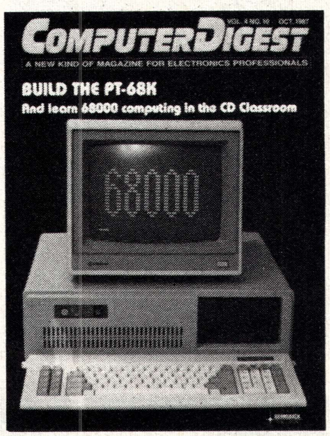
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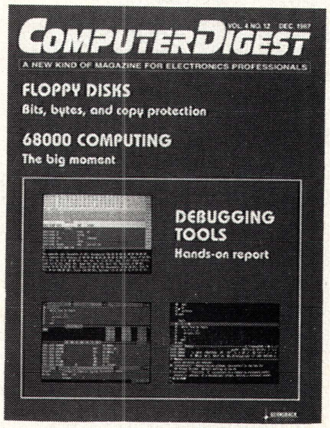

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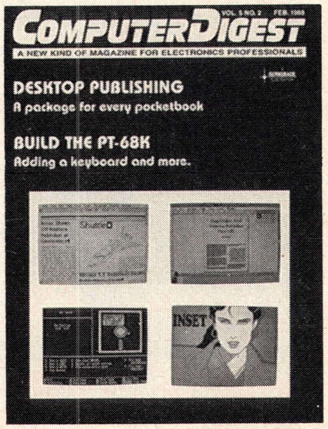

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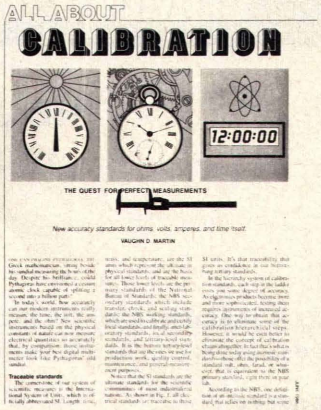

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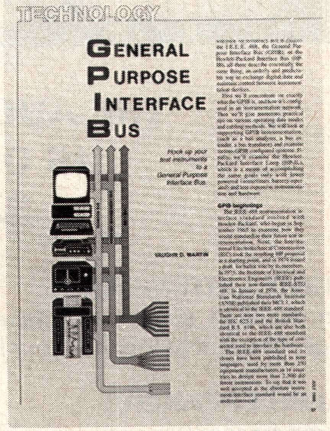

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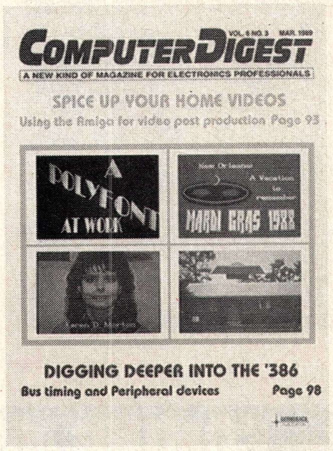
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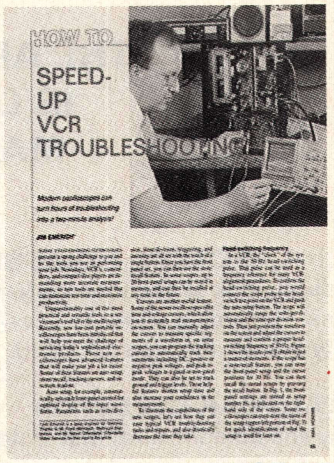
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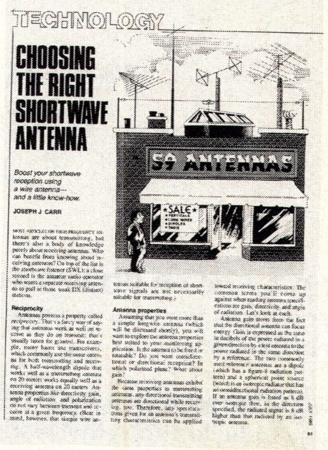
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Boost your shortwave reception using a wire antenna—and a little know-how.

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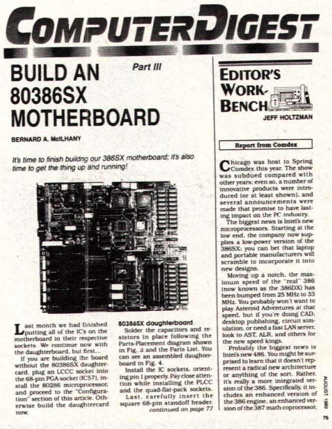

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BUILD AN 80386SX MOTHERBOARD

Part III

BERNARD A. McILHANY

It's time to finish buildng our 386SX motherboard; it's also time to get the thing up and running!

Last month we had finished putting all of the IC's on the motherboard in their respective sockets. We continue now with the daughterboard, but first...

If you are building the board without the 80386SX daughtercard, plug an LCCC socket into the 68-pin PGA socket (IC57), install the 80286 microprocessor, and proceed to the "Configuration" section of this article. Otherwise build the daughtercard now.

80386SX daughterboard

Solder the capacitors and resistors in place following the Parts-Placement diagram shown in Fig. 3 and the Parts List. You can see an assembled daughterboard in Fig. 4.

Install the IC sockets, orienting pin 1 properly. Pay close attention while installing the PLCC and the quad-flat-pack sockets.

Last, carefully insert the square 68-pin standoff header.

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EDITOR'S WORKBENCH

JEFF HOLTZMAN

Report from Comdex

Chicago was host to Spring Comdex this year. The show was subdued compared with other years; even so, a number of innovative products were introduced (or at least shown), and several announcements were made that promise to have lasting impact on the PC industry.

The biggest news is Intel's new microprocessors. Starting at the low end, the company now supplies a low-power version of the 386SX; you can bet that laptop and portable manufacturers will scramble to incorporate it into new designs.

Moving up a notch, the maximum speed of the "real" 386 (now known as the 386DX) has been bumped from 25 MHz to 33 MHz. You probably won't want to play Asteroid Adventures at that speed, but if you're doing CAD, desktop publishing, circuit simulation, or need a fast LAN server, look to AST, ALR, and others for the new speed kings.

Probably the biggest news is Intel's new 486. You might be surprised to learn that it doesn't represent a radical new architecture or anything of the sort. Rather, it's really a more integrated version of the 386. Specifically, it includes an enhanced version of the 386 engine, an enhanced version of the 387 math coprocessor.

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Music-On-Hold Adapter

The Hi-Tech Music-on-Hold Adapter

STEVE SOKOLOWSKI

HAVE YOU EVER BEEN IN THE MIDDLE OF A phone conversation, and needed to either walk away for a couple of minutes or switch lines? The kids might be crying, the washing machine might need fabric softener; whatever. Here's an inexpensive "electronic hold button" controlled by a *Touch-Tone* phone, with provision for audio for the other party, using either a music-synthesizer IC module or a radio.

Unlike normal hold buttons, this one doesn't cut your phone handset off from the other party; you can still hear one another, and also the audio, if you use it. Rather, what it does is let you provide this audio to the other party, and then lets you hang up the handset without losing your party; you can also opt for silence. When you wish to resume normal conversation, pressing the pound (#) key shuts off the audio if used, and allows you to hang up and disconnect when finished. To understand how works, you need to know how hold buttons and *Touch-Tone* phones work.

Placing a call on hold

The normal on-hook voltage of a phone line is about 50 volts, depending on particular central-office equipment. When you lift a phone's handset, 600 ohms is placed across the phone line, dropping the voltage to 5 volts. Figure 1 is a simplified representation of the hold adapter, showing hold-indicator LED1 in series with resistor R6 and relay RY1.

The hold adapter prevents a disconnection when you hang up the handset, by placing R6 and LED1 across the phone line using RY1. The synthesizer provides music for the party on hold; it can be left out if desired.

FIG. 1—BLOCK DIAGRAM OF THE Music-On-Hold Adapter. When RY1 closes, RY1's coil, R6, and LED1 in series are placed in parallel with a *Touch-Tone* across the red (Tip) and green (Ring) phone-line wires, allowing you to hang up without disconnecting your party.

***Touch-Tone* operation**

Touch-Tone phones produce *D*ual *T*one *M*ulti *F*requency (DTMF) sig-

FIG. 2—*TOUCH-TONE* KEYPAD showing all 16 keys, including the normally absent operator keys (A–D). The DTMF output for a key is the sum of the row and column sinusoids, using the frequencies listed.

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68705 MICROCONTROLLER

THOMAS HENRY

Part 2 Last time we discussed basic hardware and software theory of Motorola's versatile 68705 microcomputer-on-a-chip. We also built a special programmer used to transfer software from a standard 2716 EPROM into the 68705's built-in EPROM.

This time we will put the theory to work and build a digital alarm clock. The project is not just an educational exercise; you'll find that it is useful and that it incorporates several features not found in commercial units. By studying the example, you'll find numerous hints for designing with the 68705.

Use the versatile 68705 microcontroller to build a programmable alarm clock.

Design goals

We want a four-digit readout for hours and minutes, a blinking colon to indicate seconds, fast and slow display-set buttons, clock- and alarm-set buttons, an AM/PM indicator, an enable switch and a volume control for the alarm, the ability to show either hours and minutes or minutes and seconds, a power-outage warning, and the ability to display either a 12- or a 24-hour clock.

Those may seem like ambitious design goals. As it turns out, however, the 68705's versatility lets us build the project using only two IC's. And one of them is a dedicated sound generator, which means that the clock really requires only the 68705!

The basic plan of attack is to derive the 60-Hz timebase from the 117-VAC power lines. In most communities, that frequency is accurate to 0.02 Hz, or 3 parts in 10,000. By using the AC lines (which are more than accurate enough for a clock), we can simplify the design tremendously, and even eliminate the need for a crystal oscillator. (See part one of this story for more information on clocking the 68705.)

To simplify things even further, we multiplex the four seven-segment LED displays. Doing so means we need no latches or decoders, reducing the number of passive components as well. Port B of the 68705 can sink 10 mA of current directly, so no display drivers are needed either. Decoding is handled by means of a look-up table burned into the internal EPROM. Since we don't use a

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EDITOR'S WORK-BENCH

Announcement

Mario Maniscalco's $100 challenge to **Computer Digest** readers to crack the secret message published in the April 1988 issue has gone unanswered, so he will now send the key to anyone who sends an SASE to P.O. Box 110083, Cleveland, OH 44111. Mario also plans a newsletter on the encryption program; write to him at that address for more information.

RS-232 Debugging with SAM 2000

Woe be it to anyone trying to connect two pieces of equipment via the RS-232 "standard." Making successful connections is partly art, partly science, partly trial and error, and partly just plain luck.

If getting serial devices to communicate is important to you, you'll want to check out the SAM 2000 from IQ Technologies. (See Fig. 1.) This big brother to the Smart Data Meter (reviewed in the March 1989 issue) provides several powerful features designed to help set up and debug serial communication links.

SAM is about the size of a hand-held DMM. The basic unit includes a 2-line by 16-character LCD display, a six-button front panel, two 26-pin header con-

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ALL ABOUT

FMX: IS IT GOOD FOR FM?

Can FMX improve stereo FM reception?

LEN FELDMAN

THERE'S A BATTLE BREWING IN THE broadcast industry, and it's one that could affect the way in which we listen to FM radio and, more specifically, FM stereo radio broadcasts. On one side is a company called Broadcast Technology Partners. Its president, Mr. Emil Torick, is a distinguished engineer who spent many years at the CBS Technology Center in Connecticut before it was shut down a few years ago.

During his last years at CBS, Mr. Torick worked out a system that he maintains will decrease the background noise commonly encountered when listening to FM stereo stations whose transmitters are at a considerable distance from the FM tuner or receiver. Torick calls his system FMX. As anyone who has ever listened to stereo FM under fringe-area conditions knows only too well, programs whose background noise levels are perfectly acceptable in mono can become unlistenable when you switch to stereo. The increase in noise level can be as much as 23 dB or, in arithmetic terms, there's a 200-to-1 increase in noise power!

If FMX can make stereo FM almost as noise-free as mono FM, the number of listeners in any given area who could enjoy noise-free stereo reception would increase. From a commercial standpoint, stations could

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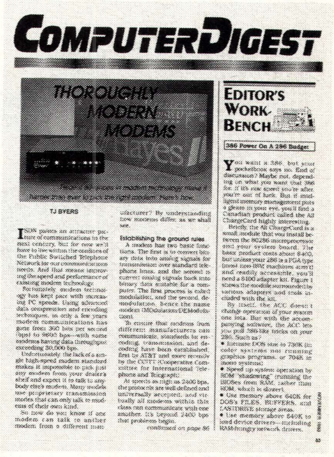

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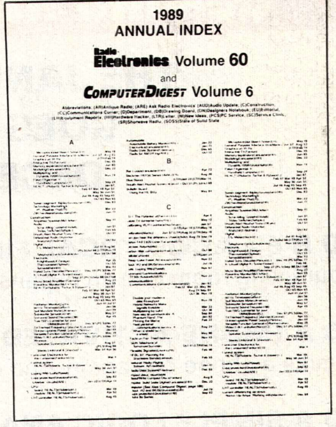
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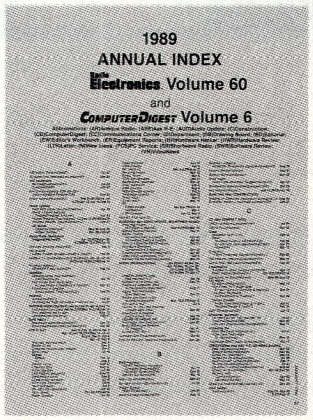

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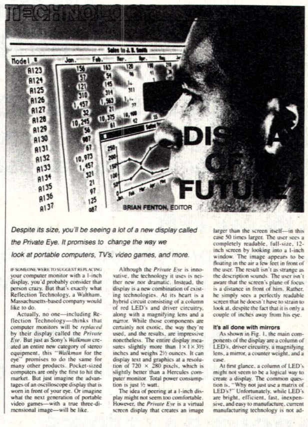

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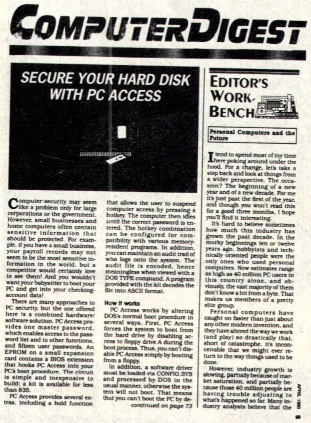

COMPUTERDIGEST

SECURE YOUR HARD DISK WITH PC ACCESS

Computer security may seem like a problem only for large corporations or the government. However, small businesses and home computers often contain sensitive information that should be protected. For example, if you have a small business, your payroll records may not seem to be the most sensitive information in the world, but a competitor would certainly love to see them! And you wouldn't want your babysitter to boot your PC and get into your checking-account data!

There are many approaches to PC security, but the one offered here is a combined hardware/software solution. PC Access provides one master password, which enables access to the password list and to other functions, and fifteen user passwords. An EPROM on a small expansion card contains a BIOS extension that hooks PC Access into your PC's boot procedure. The circuit is simple and inexpensive to build; a kit is available for less than $35.

PC Access provides several extras, including a hold function that allows the user to suspend computer access by pressing a hotkey. The computer then idles until the correct password is entered. The hotkey combination can be configured for compatibility with various memory-resident programs. In addition, you can maintain an audit trail of who logs onto the system. The audit file is encoded, hence meaningless when viewed with a DOS TYPE command. A program provided with the kit decodes the file into ASCII format.

How it works

PC Access works by altering DOS's normal boot procedure in several ways. First, PC Access forces the system to boot from the hard drive by disabling access to floppy drive A during the boot process. Thus, you can't disable PC Access simply by booting from a floppy.

In addition, a software driver must be loaded via CONFIG.SYS and processed by DOS in the usual manner, otherwise the system will not boot. That means that you can't boot the PC by de-

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Personal Computers and the Future

I tend to spend most of my time here poking around under the hood. For a change, let's take a step back and look at things from a wider perspective. The occasion? The beginning of a new year and of a new decade. For me it's just past the first of the year, and though you won't read this for a good three months, I hope you'll find it interesting.

It's hard to believe sometimes how much this industry has grown the past decade. In the murky beginnings ten or twelve years ago, hobbyists and technically oriented people were the only ones who used personal computers. Now estimates range as high as 40 million PC users in this country alone, and obviously, the vast majority of them don't know a bit from a byte. That makes us members of a pretty elite group.

Personal computers have caught on faster than just about any other modern invention, and they have altered the way we work (and play) so drastically that, short of catastrophe, it's inconceivable that we might ever return to the way things used to be done.

However, industry growth is slowing, partially because of market saturation, and partially because those 40 million people are having trouble adjusting to what's happened so far. Many industry analysts believe that the

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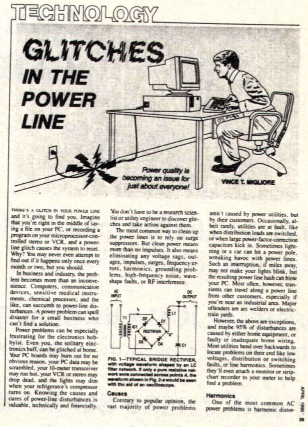

TECHNOLOGY

GLITCHES IN THE POWER LINE

Power quality is becoming an issue for just about everyone!

VINCE T. MIGLIORE

THERE'S A GLITCH IN YOUR POWER LINE and it's going to find you. Imagine that you're right in the middle of saving a file on your PC, or recording a program on your microprocessor-controlled stereo or VCR, and a power-line glitch causes the system to reset. Why? You may never even attempt to find out if it happens only once every month or two, but you should.

In business and industry, the problem becomes more than an inconvenience. Computers, communication devices, sensitive medical instruments, chemical processes, and the like, can succumb to power-line disturbances. A power problem can spell disaster for a small business who can't find a solution.

Power problems can be especially frustrating for the electronics hobbyist. Even you, the solitary electronics buff, can be glitched at home. Your PC boards may burn out for no obvious reason, your PC data may be scrambled, your 10-meter transceiver may run hot, your VCR or stereo may drop dead, and the lights may dim when your refrigerator's compressor turns on. Knowing the causes and cures of power-line disturbances is valuable, technically and financially. You don't have to be a research scientist or utility engineer to discover glitches and take action against them.

The most common way to clean up the power lines is to rely on surge suppressors. But clean power means more than no impulses. It also means eliminating any voltage sags, outages, impulses, surges, frequency errors, harmonics, grounding problems, high-frequency noise, waveshape faults, or RF interference.

FIG. 1—TYPICAL BRIDGE RECTIFIER, with voltage waveform shaped by an LC filter network. If only a pure resistive network were connected across points *A*, the waveform shown in Fig. 2-a would be seen with the aid of an oscilloscope.

Causes

Contrary to popular opinion, the vast majority of power problems aren't caused by power utilities, but by their customers. Occasionally, albeit rarely, utilities are at fault, like when distribution loads are switched, or when large power-factor-correction capacitors kick in. Sometimes lightning or a car can hit a power pole, wreaking havoc with power lines. Such an interruption, if miles away, may not make your lights blink, but the resulting power line hash can blow your PC. Most often, however, transients can travel along a power line from other customers, especially if you're near an industrial area. Major offenders are arc welders or electric-train yards.

However, the above are exceptions, and maybe 95% of disturbances are caused by either home equipment, or faulty or inadequate home wiring. Most utilities bend over backwards to locate problems on their end like low voltages, distribution or switching faults, or line harmonics. Sometimes they'll even attach a monitor or strip-chart recorder to your meter to help find a problem.

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One of the most common AC power problems is harmonic distor-

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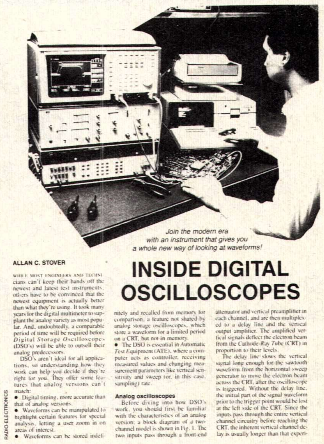

Join the modern era with an instrument that gives you a whole new way of looking at waveforms!

ALLAN C. STOVER

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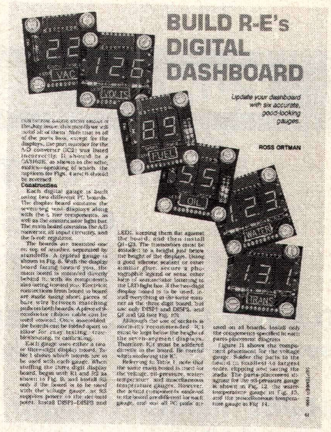

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Update your dashboard with six accurate, good-looking gauges.

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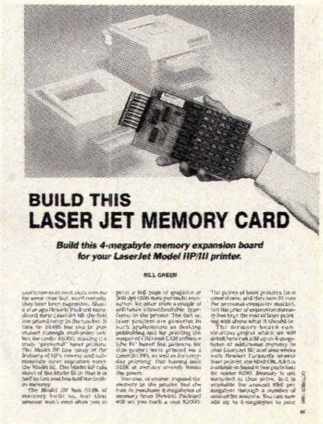

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LASER JET MEMORY CARD

Build this 4-megabyte memory expansion board for your LaserJet Model IIP/III printer.

BILL GREEN

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Here are a few tricks of the trade that may help you with your next TV repair.

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CLEO ZYMARIE

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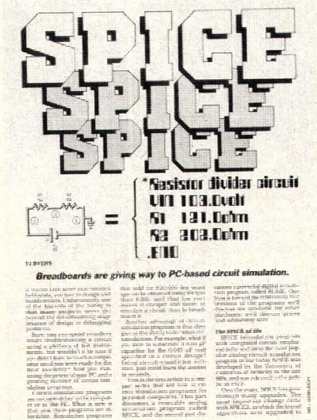
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SPICE
SPICE
*Resistor divider circuit
Breadboards are giving way to PC-based circuit simulation.

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BUILD YOUR OWN PORTABLE 146-MHz QUAD ANTENNA
LINTON G. ROBERTSON, KJ2EF
Build this portable 2-meter quad antenna. It offers plenty of punch to the pound for your next Field Day adventure.

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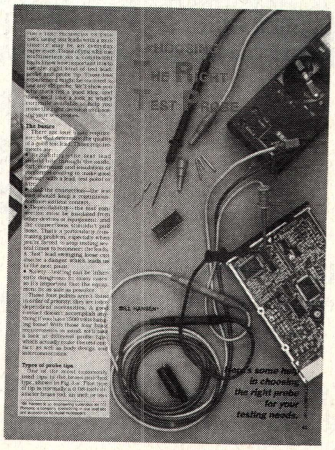

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Charles Colby

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56 **R-E's E-Z SHORTWAVE RADIO**
Build a shortwave receiver that you can modify to pick up any frequency that you're interested in!
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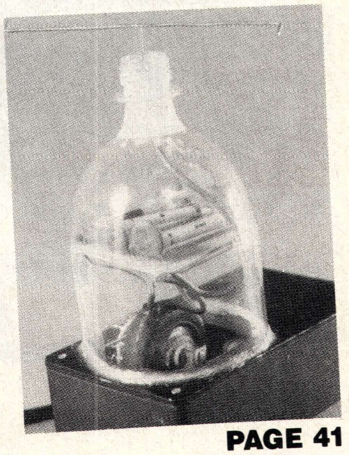

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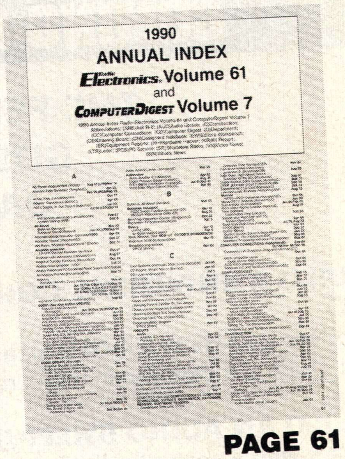

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Send and receive video pictures over standard phone lines!
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43 TURN YOUR PC INTO A UNIVERSAL FREQUENCY COUNTER
Build a frequency-counter/timer board that works with windows.
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55 AUDIO SWEEP/MARKER GENERATOR
Display the frequency response of your amplifier or filter design.
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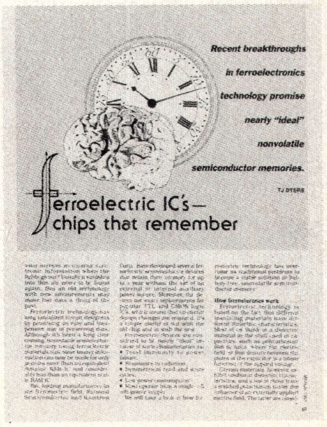

Recent breakthroughs in ferroelectronics technology promise nearly "ideal" nonvolatile semiconductor memories.

TJ BYERS

ferroelectric IC's— chips that remember

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AUDIO SWEEP/MARKER GENERATOR

JOHN WANNAMAKER

Build this sweep/marker generator and discover the audio-range frequency response of your amplifier or filter design.

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Build your own and save big bucks!
Paul Renton

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43 **LINE POWER FROM 12 VOLTS**
This 40-watt DC-to-AC inverter lets you run appliances from your car's cigarette lighter.
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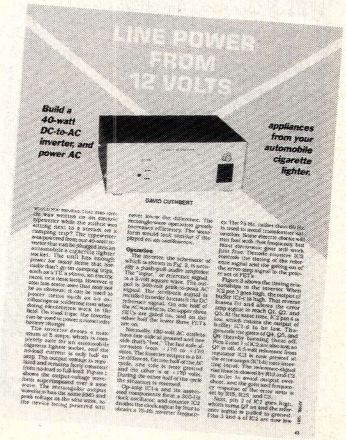
LINE POWER FROM 12 VOLTS

Build a 40-watt DC-to-AC inverter, and power AC appliances from your automobile cigarette lighter.

DAVID CUTHBERT

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Build this video telephone

Build a two-way videophone and send and receive video pictures over standard phone lines to and from anywhere in the world!

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Build an under-$60 DRAM unit that performs dynamic-RAM function, speed, and margin tests.
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41 PULSE-MATE
Our inexpensive single-shot and continuous-pulse generator offers positive and negative pulses.
David Plant

44 USE YOUR TELEPHONES AS A HOME INTERCOM SYSTEM
It's easy to do with our controller board and alert modules!
Frank Polimene

56 EXPERIMENTING WITH PC-BASED TEST EQUIPMENT
Build your own low-cost PC-based test equipment.
James J. Barbarello

PULSE-MATE

This single-shot and continuous-pulse generator is inexpensive and easy to build, yet it offers automatic level setting and both positive and negative pulses.

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USE YOUR TELEPHONES AS A HOME INTERCOM SYSTEM

It's quick and easy to add an intercom feature to your existing home telephones.

FRANK POLIMENE

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Learn some applications of, and basic troubleshooting techniques for, two switching regulator IC families.
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61 PERSONAL COMMUNICATION NETWORK
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This 16-channel, 50-MHz logic analyzer makes troubleshooting digital circuits a breeze!
Gerard Robidoux and Robert Dmitroca

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Let's add an audible indicator to our logic probe.
Robert Grossblatt

80 COMPUTER CONNECTIONS
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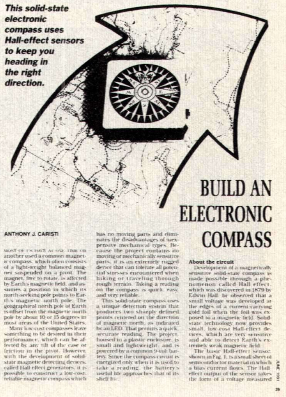
This solid-state electronic compass uses Hall-effect sensors to keep you heading in the right direction.

BUILD AN ELECTRONIC COMPASS

ANTHONY J. CARISTI

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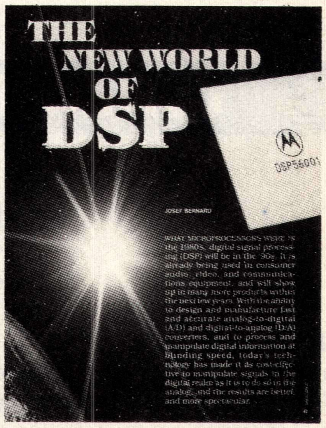
THE NEW WORLD OF DSP

JOSEF BERNARD

WHAT MICROPROCESSORS WERE TO the 1980s, digital signal processing (DSP) will be in the '90s. It is already being used in consumer audio, video, and communications equipment, and will show up in many more products within the next few years. With the ability to design and manufacture fast and accurate analog-to-digital (A/D) and digital-to-analog (D/A) converters, and to process and manipulate digital information at blinding speed, today's technology has made it as cost-effective to manipulate signals in the digital realm as it is to do so in the analog, and the results are better, and more spectacular.

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Learn about medical electronics while monitoring your heart.
H. Edwards Roberts, M.D.

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Test and troubleshoot your video equipment.
Thomas Gould

47 LOGIC ANALYZER
Check digital circuits with our 16-channel, 50-MHz logic analyzer.
Gerard Robidoux and Robert Dmitroca

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Build a PC-based IC tester for less than $100!
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Troubleshooting digital circuits is a cinch with this 16-channel, 50-MHz logic analyzer.

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COLOR BAR GENERATOR

Build this inexpensive color-bar test generator and brush up on your video skills.

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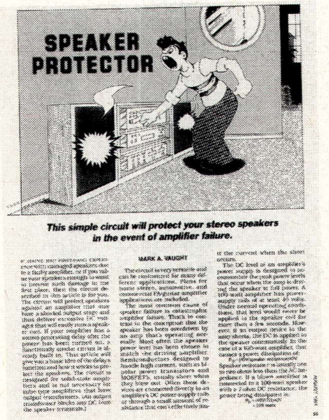
Our PC-based instrument operates from 0.1–800 MHz, and costs about $300.
Dan Doberstein and John Cardone

44 ELECTROCARDIOGRAPH
Learn about medical electronics while monitoring your heart.
H. Edward Roberts, M.D.

50 RS-232 TERMINAL/MONITOR
This device can act as a dumb terminal or as a sophisticated serial bus analyzer.
Steven Avritch

55 BUILD A SPEAKER PROTECTOR
Protect your speakers in the event of an amplifier failure.
Mark A. Vaught



SPEAKER PROTECTOR

This simple circuit will protect your stereo speakers in the event of amplifier failure.

MARK A. VAUGHT

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Voltage doublers are an easy and inexpensive way to experiment with high voltage.

RALPH HUBSCHER

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33 **PC-TO-TV CONVERTER**
Our VGA to NTSC television adapter is your computer's link to the outside video world.
Anthony Stevens

39 **VOCAL EFFECTS/MIXER**
Use it to create a multiple-echo effect and to mix audio from various sources.
Terry Weeder

43 **DIGITAL SINEWAVE SYNTHESIZER**
Generate low-distortion waves digitally.
Steven D. Swift

60 **R-E's CALL ALERT**
It eliminates the chatter on your favorite channel or repeater.
Rodney A. Kreuter and David Plant

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This inexpensive logic-analyzer kit simplifies microprocessor design
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DIGITAL SINEWAVE SYNTHESIZER

Build this direct digital synthesizer, and generate low-distortion sine waves digitally.

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VOCAL EFFECTS/ MIXER

Build this vocal effects mixer and get studio-quality sound "reverberations" in your recordings.

TERRY WEEDER

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Use ultrasound to listen to your heart beat.
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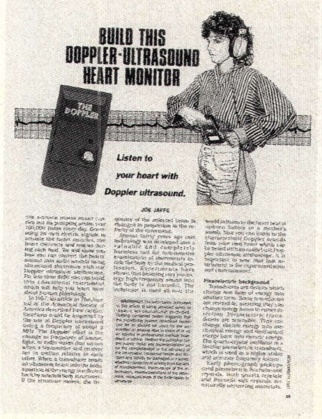
58 MUSIC ON HOLD
Have your phone play FM music to callers waiting on hold.
Phil Hausman

67 MICRO MONITOR
Construction details for the logic analyzer kit.
Jim Cooke

71 874X PROGRAMMER
Use this easy program to experiment with 8789H and 8749H series of microcontrollers.
Fred Eady

84 SIMPLE FM TRANSMITTER
A one-evening project, even for beginners!
James A. Melton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DOPPLER-ULTRASOUND
HEART MONITOR

Listen to your heart with Doppler ultrasound.

JOE JAFFE

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This handy FM transmitter makes a great one-evening project, even for first-time builders!

JAMES A. MELTON

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How much power do your appliances use?
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Build the Frugalvision image-capture board for less than $100.
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Our inexpensive Total Harmonic Distortion analyzer tells you how good your amplifier really is.
John F. Keidel

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Get the most from your rechargeable batteries with this microcontroller-based discharger.
Fred Eady

63 ELECTRONIC FUSE
Use this handy device when troubleshooting your next project
T.L. Petruzellis

BUILD THIS

THD ANALYZER

How good is your amplifier? Our inexpensive THD analyzer will let you know.

JOHN F. KEIDEL

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BUILD THE BATTERY TOOL

Get the most out of your rechargeable batteries with this microcontroller-based battery discharger.

FRED EADY

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Generate square, triangle, and sine waves with this inexpensive benchtop instrument.
Michael A. Lashansky

43 SPEAKER MATE
Turn any regular telephone into a high-quality speakerphone!
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Troubleshoot computer monitors without hooking them up to a computer.
Garth Price

59 EXPERIMENTING WITH ADC FOR YOUR PC
Build a low-cost automatic data-capture system.
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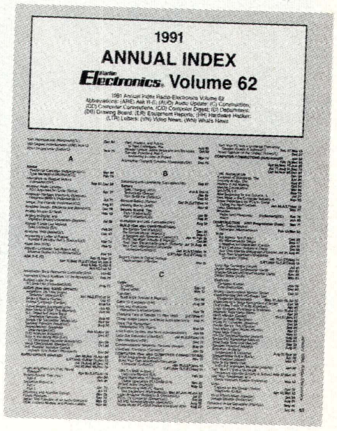

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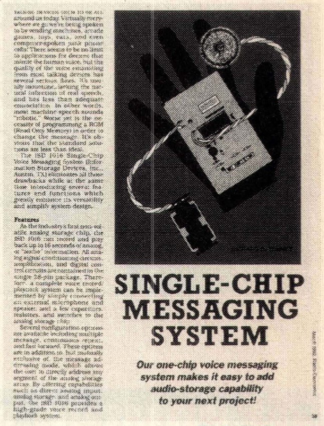

SINGLE-CHIP MESSAGING SYSTEM

Our one-chip voice messaging system makes it easy to add audio-storage capability to your next project!

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INTELLIGENT PHONE-LINE MONITOR

Log telephone/modem/fax usage automatically and inexpensively with our intelligent phone-line monitor.

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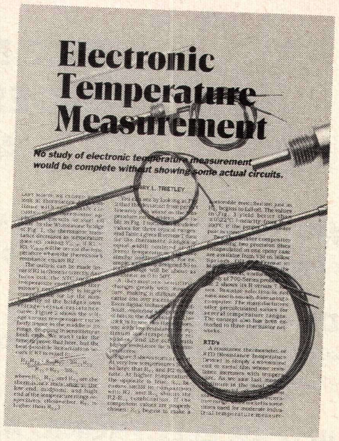

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RAY M. MARSTON

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ATV
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How fast are your reflexes? The reflex timer will show you.

DAN KENNEDY

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JAMES MELTON

Power small appliances from your car or any other 12-volt source with our 250-watt inverter.

250 WATT POWER INVERTER

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